

EDWARDS AIR FORCE BASE, NORTH BASE
(Edwards Air Force Base, Muroc Flight Test Base)
North Base Rd.
Boron vicinity
Kern County
California

HAER No. CA-170

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PHOTOGRAPHS

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HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC GREAT BASIN SUPPORT OFFICE
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HISTORIC AMERICAN ENGINEERING RECORD

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(Muroc Flight Test Base)

HAER No. CA-170

Location: Edwards Air Force Base
Boron vicinity
Kern County
California
UTM coordinates of property line:
11.420380.3872160, 11.422310.3872620,
11.420280.3872360, USGS 7.5 min Edwards
quadrangle, 1973;
11.421570.3871510, 11.420280.3870520, USGS
7.5 min Rogers Lake North quadrangle, 1973.

Dates of Construction: 1942, with major construction programs in
1943, 1944, 1945, 1947, 1953, 1967-70.
Modifications to individual facilities
occurred on an as-needed basis into the
1990s.

Fabricator: 1942-present: United States Army Corps of
Engineers and numerous private sector
contractors.

Present Owner: United States Air Force.

Present Use: Active airfield.

Significance: North Base originated as a remote, secret
facility to test the United States' first
jet-propelled military aircraft, the Bell
XP-59A Airacomet. During World War II,
facilities grew to accommodate more than 400
personnel and four active hangars. After the
war, North Base remained a test facility
which supported the testing and development
of advanced aircraft. Such planes as the
Northrop YB-49 *Flying Wing*, XP-80 *Shooting
Star*, North American F-86 *Sabre*, North
American Aviation XB-45 *Tornado*, Douglas XB-
43 *Versatile II*, Convair XB-46, North
American Aviation F-100 *Super Sabre*,
McDonnell F-101 *Voodoo*, Lockheed XFV-1 *Pogo*,
Lockheed U-2, and many others.

Historian: Scott M. Hudlow, Architectural Historian,
Computer Sciences Corporation, Edwards AFB,
California. July 1995-December 1995.

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Historical Context and Evaluation

The legacy of Edwards Air Force Base (AFB) as a preeminent flight test center is due, in a large part, to the important work conducted at the Muroc Flight Test Base, now called North Base, in the early 1940s. The Air Force Flight Test Center (AFFTC) is a direct outgrowth of the Muroc Flight Test Base, the Army's, and later the Air Force's, flight test base. During World War II, North Base was known as the Materiel Command Flight Test Center, Muroc Flight Test Center, and eventually Muroc Flight Test Base. The name "North Base" was first coined in the late 1940s.¹ The Muroc Flight Test Base was an autonomous command originally under the jurisdiction of Materiel Command; after September 1944 it was under the jurisdiction of Air Technical Service Command when it was created from the merger of Materiel Command and Air Service Command.² Muroc's diverse military facilities were united under the nomenclature of Muroc AFB when the Air Force was created in 1947.

The Muroc Flight Test Base was the setting where America's first jet, the XP-59A Airacomet, was test flown. The first American production jet, the XP-80 *Shooting Star*, also took its maiden flight from Muroc Flight Test Base, as well as a wide variety of experimental planes and prototypes. World War II brought pressures for technological advances that would provide the United States (U.S.) with a military edge that would quickly end the war. These pressures prompted the Muroc Flight Test Base's creation. The global struggle between the United States and the Soviet Union, the Cold War, sustained the pressures for continually enhanced military capabilities, which helped to maintain Muroc Flight Test Base's role as an important testing facility for new aerospace technology in the post-World War II period.

¹. John G. Griggs, Colonel, USAF, Chief, Air Installations Division to Chief of Staff, U.S. Air Force, Washington 25, D.C.; "Acquisition of Land, Segment A, Muroc Air Force Base, February 2, 1948"; General Correspondence, Headquarters United States Air Force, Office of the Assistant Chief of Staff, Installations, Muroc Air Force Base, Record Group 341, National Archives, Washington, D.C.

². Walker, Lois E. and Shelby E. Wickam. *From Huffman Prairie to the Moon: The History of Wright-Patterson Air Force Base*. Office of History, 2750th Air Base Wing, Wright-Patterson Air Force Base, Ohio, 1985:163.

Early Flight and Aircraft Development

The Muroc Flight Test Base's flight test role derived from a tradition of military research and development which began in the early 20th century.

Man's attempts to conquer the sky goes back for centuries, but the first successful powered flight came in late 1903. Two Ohio shopkeepers, Orville and Wilbur Wright, exemplified the early explorers of flight. Basing their experiments on practical data acquired by a number of flight researchers from previous centuries, the Wright brothers used a common sense, step-by-step approach to the problems of flight. The Wright brothers' approaches, like that of other contemporary flight researchers, were quite distinct from the professional engineering and scientific elite.³ The Wrights were simple, middle class midwesterners with little in the way of engineering backgrounds, but they attacked their problem with a great degree of order and shop room sense.⁴ On 17 December 1903, the Wright *Flyer* flew 120 feet at Kitty Hawk, North Carolina, marking man's first powered flight.

Other early flight pioneers such as Glenn Curtiss and Glenn L. Martin, contemporaries of the Wrights, helped conquer the skies in a fashion markedly different from the modern aeronautic industry. Martin and Curtiss were known as "eccentrics"; they pursued their dreams largely on their own, isolated from American business and government, unlike their European counterparts. These men were simple provincial mechanics with a common dream.

Glenn L. Martin, at an exposition in Los Angeles in 1912, finally attracted the attention of the American military. In front of a large group of expectant onlookers, Martin flew his plane (based on a Curtiss design) over a fake fort, dropping bombs into the structure's interior. These aerial attacks produced such devastating results to the fort that it was in ruins by the demonstration's end. Martin amply demonstrated an obvious military use for flight. He was soon elevated from an

³. Noble, David. *America by Design: Science, Technology, and the Rise of Corporate Capitalism*. New York, New York: Oxford University Press, 1977, passim.

⁴. Biddle, Wayne. *Barons of the Sky: From Early Flight to Strategic Warfare, The Story of the American Aerospace Industry*. New York, New York: Simon and Schuster, 1991:26-28.

eccentric, flying fool to a genuine hero.⁵ Martin immediately began working on new plane types for the Army, aircraft that brought a whole new meaning to warfare. The Army, however, remained hesitant and refused to wholeheartedly embrace aviation.⁶

The Aeronautical Division of the U.S. Army's Signal Corps was founded in 1907; its staff originally consisted of only one officer and two enlisted men. Within four years, the staff had grown to 23 people including six pilots and five aircraft, however, the Army's efforts lagged far behind many European countries. In 1911, the Army established its first flight school in College Park, Maryland, north of Washington, D.C. to train its pilots and aircrews. Two years later the school was moved to North Island, San Diego, California.⁷

In 1915, the Federal Government made another important stride forward by creating the National Advisory Committee for Aeronautics (NACA) (NACA then; National Aeronautics and Space Administration [NASA] after 1958) to scientifically study powered flight. NACA was composed of representatives from the War, Navy, Treasury, Commerce, and Agriculture Departments; it was tasked to direct studies that would generate data vital to the improvement of American military aviation.

Congress granted NACA the authority to conduct research and experimentation in any laboratory, in whole or in part, which may be assigned to it. NACA discovered, however, that no aircraft testing facility existed. In the summer of 1916, NACA concluded it had no alternative but to construct its own research facility, one that it would share jointly with the Army and the Navy. As such, NACA created a flight research center at Langley Field, Hampton, Virginia where aircraft were tested in wind tunnels and in the air.⁸

In marked contrast, many European governments fully supported flight research. For example, by 1913, piston-driven, monocoque (single-wing) type airplanes could be found throughout

⁵. Biddle, 58-60.

⁶. Biddle, 65.

⁷. Walker and Wickam, 17.

⁸. Hallion, Richard P. *Test Pilots: The Frontiersmen of Flight*. Washington D.C.: Smithsonian Institution Press, 1988:72; Walker and Wickam, 85.

Europe. These planes made the Wright *Flyer* obsolete.⁹

World War I

World War I marked a major watershed in American aviation, as the exigencies of war finally brought government support to flight research. This important change eventually led to a cooperation among academic, business, and government representatives. Aviation, so neglected before the war, was swallowed completely by the Great War. The beginnings of the military-industrial complex emerged in 1917. The U.S. Government, finally recognizing the importance of flight, forced the newly formed Wright-Martin Company to open its patent rights to airplane designs. This move prevented the formation of an airplane monopoly by Wright-Martin and paved the way for the establishment of an airplane manufacturing industry.¹⁰

The Federal Government established the Aircraft Production Board in April 1917. Its mandate was to coordinate the activities of the nation's aircraft manufacturers. The Board was also responsible to ensure the availability of the resources and raw materials required by the manufacturers. The Board worked on behalf of the War Department and the Department of the Navy.¹¹ The Board hoping to build as many planes as soon as possible, decreed that European plane types should be copied, particularly the DeHaviland DH-4 and a single-engine type, the "Liberty," should be used. The engine and the idea were flawed, hence, a single American plane did not fight in World War I.¹²

The Army established McCook Field in downtown Dayton, Ohio in October 1917 as the Army's flight testing base. It operated under the mantle of the Airplane Engineering Department of the Signal Corps' Equipment Division. McCook's mission "...was to research, develop, test and evaluate U.S. military aircraft."¹³ A second Army base was located in Dayton, Ohio, Wilbur Wright Field. Wilbur Wright Field supported McCook's mission by supplying equipment, hangar and shop space, and trained mechanics. McCook Field in return trained Wilbur Wright Field's

⁹. Hallion, 68.

¹⁰. Biddle, 92.

¹¹. Walker and Wickam, 86-87.

¹². Biddle, 96.

¹³. Walker and Wickam, 43.

mechanics and upgraded their pilots on the DeHaviland DH-4.

When World War I ended in November 1918, McCook's mission was limited the testing experimental and test aircraft. It particularly used surplus DeHaviland DH-4s equipped with Liberty engines until their supply ended in 1931. Nearby Wilbur Wright Field ceased supporting McCook's test mission and became the Wilbur Wright Air Service Depot. These two nearby bases remained separate until 1927, when McCook merged with Wilbur Wright to form Wright Field.¹⁴

The 1920s

After World War I, aircraft research continued at a rapid pace. This time the Federal Government was fully involved. In 1919, Congress passed an Army Appropriations Bill authorizing the Army to build 40 times more planes than before. Flight research continued during the 1920s. New aircraft companies began to emerge which took advantage of the new interest in flight. Many of the early shop room floor mechanics began forming companies, or worked as engineers for new, expanding aircraft companies. For example, Malcolm and Allan Loughead built the Lockheed Corporation from the ground up. Aircraft engineers such as Donald Douglas, who worked for the Loughead brothers, established his own company. He in turn hired new talent, such as Jack Northrop, who later formed his own company. The Federal Government implemented a competitive bid system for contracts with these companies in 1921.

In the 1920s, interest and investment in civil and military aircraft was stagnant until Charles Lindbergh's successful 1927 trans-Atlantic flight.¹⁵ The enthusiasm was temporarily checked by the 1929 stock market crash and the ensuing economic depression, but not before a number of important advances were made.¹⁶

A variety of flight problems had been conquered in the 1920s, thanks, in large part, to research done by NACA at Langley Field, the Army at McCook (later Wright) Field, the Guggenheim Fund for the Promotion of Aeronautics, and many brilliant

¹⁴. Walker and Wickam, 45-7.

¹⁵. Kelsey, Benjamin S. *The Dragon's Teeth: The Creation of United States Air Power for World War II*. Washington, D.C.: Smithsonian Institution Press, 1982:10.

¹⁶. Hallion, 94-97.

engineers working at various aircraft companies. For example, cockpit pressurization and advances in board instrumentation began in the 1920s. These important advances allowed pilots to fly blind in adverse weather conditions and rely less on their easily fooled human senses.

Many significant aircraft developments occurred at McCook. These major engineering developments and achievements included controllable and reversible pitch propellers, turbosuperchargers which boosted engine power in lower oxygen environments, bullet-proof and leak-proof gasoline tanks, the radio beam, a non-magnetic aircraft clock, an ambulance airplane, the air-cooled radial engine, mapping and night observation cameras, the free-fall parachute, night-flying techniques and the model runway.¹⁷ James Doolittle, in the 1920s, also gathered data on airframe designs. He test flew captured World War I German planes for the Army Air Corps for study purposes.¹⁸

The Materiel Division, forerunner to World War II's Materiel Command, was founded in 1926 at McCook Field. Materiel Division was established as one of the three major components of the newly-designated Army Air Corps. The Army Air Corps was formerly known as the Air Service. Materiel Division was transferred to Wright Field in 1927.¹⁹

The 1930s and 1940s

Despite the Great Depression, airplane research continued in the 1930s. Advances made in the 1920s were applied during the 1930s. Streamlining, variable pitch propellers, wing flaps, and various engine improvements were among the innovations. Many record breaking flights occurred during this period. Planes flew higher, faster, and farther than ever before. The Boeing 247, Douglas DC-3, and the Northrop Vega characterized many of these technological advances.²⁰

Flight testing had changed drastically by the 1930s; the process for testing a plane slowly became methodical, ordered,

¹⁷. Hallion, 76; Walker and Wickam, 99.

¹⁸. Hallion, 82-84.

¹⁹. Walker and Wickam, 127.

²⁰. Bilstein, Roger E. *Flight in America, 1900-1983: From the Wrights to the Astronauts*. Baltimore, Maryland: Johns Hopkins University Press, 1984:83-87.

and complex. No longer could a "flying fool" simply climb into the cockpit of a new plane and fly it. The 1930s test pilots tried a variety of new maneuvers as planes became faster and more versatile. Power dives and spinning became mainstays of flight test during this period. Flight testing continued to be a dangerous occupation.²¹ Wright Field had a multitude of laboratories to support new scientific aircraft testing. The Structures Development and Test Laboratory, Special Research and Test Laboratory, Propeller Research and Test Laboratory, Aerodynamics Research and Test Laboratory, Accessory Design and Test Laboratory, Dynamometer Laboratory, the Torque Stand complex, Fuel Test Laboratory, and the Power Plant Branch were located at Wright Field to provide for anticipated testing needs.²² Although the Materiel Division found Wright Field to be an excellent location for its operations, it found the location was not secure enough for flight testing its increasingly more sophisticated and large military aircraft.

The aircraft industry was linked umbilically to the military during this period; it had become clear that the U.S. Government was the industry's chief aircraft purchaser. Despite the association between industry and Government, the Army Air Corps by the late 1930s was having difficulty acquiring the types of planes that it needed. A majority of the production planes were disappointing, and did not live up to performance expectations.²³ United States air power and power plant technology in the late 1930s remained behind that of most European countries. In 1938, General Henry H. "Hap" Arnold admitted that "No facilities now exist in the United States for tests in connection with developments of engine and supercharger combinations."²⁴ The 1939 Curtiss P-36 fighter, for example, was viewed by many as an inferior fighter plane to the British *Spitfire* and German Focke Wulf and Messerschmitt fighters.²⁵

²¹. Biddle, 131.

²². Walker and Wickam, 130-33.

²³. Bilstein, 125; Kelsey, *passim*.

²⁴. H.H. Arnold, Brig. General, Air Corps, Acting Chief of the Air Corps to The Adjutant General; "Power Plant Testing Laboratory, Wright Field, Ohio, September 14, 1938"; General Correspondence, 1917-1938; Air Adjutant General, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

²⁵. Bilstein, 126-128.

The Spanish Civil War displayed the devastation that could be brought by fighter and bomber planes. As war clouds loomed over Europe, the U.S. Army Air Corps realized that newer, better, and larger numbers of planes would be needed to successfully defend America's global interests. Old order resistance to air power and flight research, which went back to the turn of the century, was finally silenced during this period as the need for air power became indisputable.²⁶

World War II prompted massive Government involvement in the aeronautical industry. A strong air force was perceived as a key to a successful war effort. The Federal Government funded a massive aeronautical industry for this reason.²⁷ It contracted for the construction of 304,139 airframes and 812,615 engines between 1939 and 1945. Aircraft companies such as Bell, Lockheed, Grumman, Republic, Northrop, Douglas, Martin, and Boeing were made adjunct to the Federal Government during the war. These companies lost most pretence of private, commercial status. The Federal Government mandated that commercial production was a secondary concern in relation to military aircraft construction.²⁸

In addition to production, the Federal Government also became heavily involved in aircraft research and experimentation. Flight testing became more institutionalized and standardized during the war. NACA displayed an aspect of this institutionalization; it wrote a flight test guidebook for the military entitled *Requirements for Satisfactory Flying Qualities of Airplanes*, similar to volumes it had written earlier in the 20th century.²⁹

These flight tests and other research needed to be conducted in secrecy. Current research locations such as Langley Field, Wright Field, McCook Field, and Bolling Field (south of Washington D.C. on the Anacostia River in Virginia) were not isolated enough; flight test activities could be seen by casual

²⁶. Bright, Charles D. *The Jet Makers: The Aerospace Industry from 1945 to 1972*. Lawrence, Kansas: The Regents Press of Kansas, 1978:2-3.

²⁷. Sherry, Michael S. *The Rise of American Air Power: The Creation of Armageddon*. New Haven, Connecticut: Yale University Press, 1987:passim.

²⁸. Biddle, 270-280.

²⁹. Hallion, 156-157.

observers. For this reason, the Army Air Corps wanted to move its secret flight test operations to an isolated, unpopulated area such as Muroc Dry Lake in the Mojave Desert or Utah's Bonneville Salt Flats.

The U.S. military acted slowly to develop the jet engine. NACA had decided to rely upon the dependable reciprocating piston-driven engine, and the Navy, in 1941, dismissed the jet engine as unworkable for aircraft. However, the German He.178, the world's first jet plane, first flew on 27 August 1939, unbeknownst to the Navy or NACA.³⁰

Jet engine research, in fact, dates to the early 1930s. Frank Whittle, a young Royal Air Force (RAF) pilot and engineer, and Hans Van Ohain, a German engineer, concurrently began researching jet engine designs. Whittle's formative ideas on the jet engine were not accepted by his RAF superiors. Whittle formed Power Jets, Ltd. in 1937 to fully explore the jet concept. The concept finally obtained Government support when his ideas came to fruition in the late 1930s. Great Britain's first jet, the E.28/39 Gloster Meteor powered by the Whittle W.2B jet engine, flew in 1941.³¹

General Arnold, as commandant of the Army Air Corps, made a visit to England several months prior to the Gloster Meteor's initial flight. Arnold realized how close the British were to having a jet airplane, and upon his return pushed for further American jet research. Arnold's prodding resulted in a contract awarded in September 1941 to the Bell Aircraft Company of Buffalo, New York, for the development of a jet aircraft. The jet engine itself was to be manufactured by GE.³² Bell was chosen for a number of reasons: the company's low workload, its proximity to GE, and its remote research areas where classified research could be undertaken. GE was selected to construct the jet engine because of its extensive research on gas turbine engines performed under Dr. Sanford Moss' direction between 1918

³⁰. Angelucci, Enzo. *The Rand McNally Encyclopedia of Military Aircraft, 1914-1980*. New York, New York: The Military Press, 1983:240.

³¹. Hallion, 151.

³². Hallion, 168-169.

and World War II.³³

The new project, designated MX-397 by the Army Air Corps, was shrouded in secrecy. Six Bell aircraft company engineers began work immediately on the project. They kept their work secret from their fellow employees and family members. This group of secret engineers was given eight months to finish the project at a total cost of \$1,644,431.³⁴

In October 1941, through a joint British and American effort, a Power Jets, Ltd. W.2B jet engine was flown to the U.S. to serve as a model for GE's jet engine. By April 1942, GE developed its I-A, which was a centrifugal, reverse-flow engine that generated 1250 pounds of thrust, similar to Whittle's W.2B.³⁵

While the engine was under development, Bell slowly progressed on the airframe. Security needs prevented the use of a wind tunnel to perform routine aerodynamic tests on the airframe. The project was so secretive that much of the work on the airframe was performed in the second story of a former Buffalo, New York Ford dealership; the windows were covered and the entrances guarded round the clock.³⁶ The skies over Buffalo were deemed unsuitable for the upcoming test flight- the military reservation at Muroc was selected as an appropriate location in early 1942. This new flight test base was termed the Muroc or the Materiel Command Flight Test Base. It was colloquially known as Muroc II, or the Wright Field of the West.

Muroc Bombing and Gunnery Range

The 1930s was a period of expansion for the Army Air Corps. Whereas 21 Air Bases and Depots had been active in the 1920s, by the late 1930s, over 100 Bases had been established, including

³³. Carpenter, David M. *Flame Powered: The Bell XP-59A Airacomet and the General Electric I-A Engine.* Jet Pioneers of America. Published privately, 1992:5-12.

³⁴. Carpenter, 14.

³⁵. Carpenter, 17.

³⁶. Carpenter, 19.

the Muroc Bombing and Gunnery Range.³⁷ Increasingly sophisticated weaponry encouraged the setting aside of large open spaces for training purposes.³⁸ The Army Air Corps, in 1931, directed Colonel Arnold to find a suitable West Coast location for bombing and gunnery practice within flying range of March Field. The Army needed an isolated place to perfect the relatively new practices of aerial bombing and attacking. The Army also desired to be relatively close to March Field where West Coast flight operations were then headquartered. The Muroc Dry Lake region offered the bombing range the benefits of the area's topography, the lakebed, lack of population, and excellent year-round flying weather. The Muroc Bombing and Gunnery Range was considered a sub-post of March Field in Riverside, California.

Colonel Arnold instantly recognized the usefulness of Muroc Dry Lake, in the hot, dry, and windy Mojave Desert. Arnold noted that:

It [Muroc Dry Lake] is flat; level; and free of brush, trees and other obstructions. Bursts of bombs and machine gun fire can be spotted very accurately. Visibility is excellent from distant ranging stations, and the level nature of the ground permits accurate measurements by tape... The lake bed is essential for practice against moving ground targets. Due to the hard and unobstructed surface, mobile targets can operate over it in any direction for approximately eleven months out of the year.³⁹

Muroc Dry Lake was ideal because of its length and unusual levelness.⁴⁰ Previous military operations recognized Muroc

³⁷. Kreger, Robert David. The Making of an Institutional Landscape: Case Studies of Air Force Bases, World War I to the Present. Ph.D. diss., University of Illinois, Champaign, Illinois, 1988, pg. 12.

³⁸. Kreger, 15.

³⁹. Delos Emmons, Brig. General, Air Corps, Commanding to the Commanding General, GHQ Air Force, Langley Field, Hampton, Virginia; "Extension of Muroc Bombing and Gunnery Range, August 23, 1936"; General Correspondence, 1917-1938; Air Adjutant General, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁴⁰. Maurer, Maurer. Aviation in the U.S. Army, 1919-1939. Washington D.C.: Office of Air Force History, 1978:382.

Lake's value as a flight center; National Guard units, as early as 1928, utilized the lakebed.⁴¹ Northrop Corporation also tested its first flying wing, the X-216H, on the dry lake in 1929.⁴²

The Federal Government owned approximately one-half of the land desired by the Air Corps. The remainder was owned by the Atchison, Topeka, and Santa Fe Railroad (AT&SF) and private homesteaders. The Government proceeded to obtain title to the land in the 1930s. President Franklin D. Roosevelt signed Executive Order 6588, which formally created the Muroc Bombing and Gunnery Range on 6 February 1934, yet, the Army Air Corps had effective possession of the area in September 1933.⁴³

After this Executive Order was signed, a tent city was established and operations got underway. The original camp was located on the east side of Muroc Dry Lake. It was a part-time facility. The Bombing and Gunnery Range was in use only when units were flown in from other fields, however, the bombing range was staffed by a permanent detachment from March Field. The Muroc Bombing and Gunnery Range was the first military base at Muroc. The Army considered the Mojave Desert unlivable, and would not permanently station troops at the Muroc Bombing and Gunnery Range. Yet the Air Corps built a barrack, mess hall, storehouse, radio station, two underground magazines, and had dug a well at the Bombing and Gunnery Range by late 1935.⁴⁴

Due to the remoteness of the Base and the adverse

⁴¹. Hudlow, Scott M. *Research Design for the Cultural Resource Evaluation of the North Base Complex, Edwards Air Force Base, California.*, 1994, pg. 21. Report on file, AFFTC/EM, Edwards AFB, California.

⁴². Biddle, 177; James O. Young. "The Golden Age at Muroc-Edwards." *Journal of the West* 30, no. 1 (1991):71.

⁴³. "H.R. 8050, May 14, 1935"; Air Adjutant General, 1917-1938, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.; Young, 69.

⁴⁴. H.H. Arnold, Brigadier General, Air Corps, Commanding to the Commanding General, Ninth Corps Area, General Headquarters Air Force, March Field, California; "Development of Muroc Bombing and Gunnery Range, September 29, 1935"; Air Adjutant General, 1917-1938, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

environmental conditions, Muroc was not a popular assignment. Major General Muir Fairchild stated that Muroc was "...out in the middle of hell's half acre".⁴⁵ One standard joke related that an old-timer, feeling a few drops of rain, was so surprised that he fainted and could only be revived by throwing a bucket of sand in his face.⁴⁶

Top Air Corps brass from all over the country visited the Muroc Bombing and Gunnery Range for the Army Air Corps' maneuvers in May 1937. More than 100 planes of varying types flew practice runs for this event, which apparently impressed the visitors. Shortly thereafter on 21 April 1938, the War Department allocated an additional 150,000 acres of land for the Air Corps. The Federal Government then filed a condemnation suit for immediate possession of 59,163 additional acres for use by the Muroc Bombing and Gunnery Range on 20 July 1939. The Army, thereafter, owned the entire eastern half of modern Edwards AFB and had secured the rights to use the entire lakebed.⁴⁷

The Muroc Bombing and Gunnery Range was only a temporary solution; a permanent Base was Colonel Arnold's goal. Brigadier General Delos Emmons noted in 1936 that a location was:

...desired to establish the permanent camp site...on the west side of the lake bed, near the town of Muroc. This location gives better rail and road communications, and provides a better water supply and camp site. It gives a better location for a landing field, since the prevailing wind is from the northwest. The present landing area on the east side of the lake bed is frequently subject to heavy sands and dust storms. Also in case of wet weather the west side dries out more quickly, and consequently operations from that side will be affected to a lesser degree.⁴⁸

⁴⁵. "Swimming Pool at Muroc Army Air Base, August 12, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁴⁶. Young, 69.

⁴⁷. Hudlow, 22.

⁴⁸. Delos Emmons, Brig. General, Air Corps, Commanding to the Commanding General, GHQ Air Force, Langley Field, Hampton, Virginia; "Extension of Muroc Bombing and Gunnery Range, August 23, 1936"; General Correspondence, 1917-1938; Air Adjutant General, Records of the Army Air Corps, Muroc Bombing and Gunnery Range,

As such, the Muroc Bombing and Gunnery Range expanded rapidly in 1940 and 1941. It moved its base location to the southwest side of Muroc Dry Lake, two miles south of the town of Muroc. On 21 June 1940, the Muroc Bombing and Gunnery Range was officially activated as a separate post under the command of Captain Glen L. Arbogast. Robert Kreger, geographer, notes that rapid landscape change is endemic to military planning. He reports: "...ongoing actions that alter an Air Force base's landscape can...perpetuate and intensify an ongoing land use slowly or incrementally, or they may abruptly reconfigure a base's land use pattern or physical appearance overnight."⁴⁹ This pattern was repeated with the appearance of the Muroc Flight Test Base in the spring of 1942 at the north end of the lakebed.

World War II's onset changed the focus of the Muroc Bombing and Gunnery Range, and introduced new facilities such as the Muroc Flight Test Base. The main Base's name was changed to Muroc Army Air Base (AAB) in 1942, a change which reflected not only an organizational change, but a change in the Base's mission. Muroc AAB became a flight training base. Flight crews, particularly P-38 *Lightning*, B-17 *Flying Fortress*, and B-24 *Liberator* aircrews were trained at Muroc AAB during World War II. B-29 *Super Fortress* lead school was also located at Muroc AAB. Many flight crews subsequently served in the Pacific and Europe.⁵⁰ The Base expanded rapidly between 1940 and 1942, as it became home to thousands of young Army pilots and aircrew members.

Muroc's remote setting and the fact that the Army already owned the property, and the excellent year-round flying conditions made it a likely candidate to house a top secret flight test facility. The bombing and gunnery range was located on Muroc Dry Lake's east shore, the permanent Base was located on Muroc Dry Lake's southeast shore, south of the AT&SF railroad line which separated the northern third of the lakebed from the bottom two-thirds. The Army acknowledged the convenience of the AT&SF rail line across the lakebed and its importance to their decision-making process. Brigadier General Franklin O. Carroll, Chief, Engineering Division of Materiel Command, wrote "At the present time the northern end of Muroc Dry Lake, separated from

Record Group 18, National Archives, Washington D.C.

⁴⁹. Kreger, 13.

⁵⁰. Young, James O. "Ad Inexplorata: A Photo History of Edwards Air Force Base." Manuscript on file, AFFTC/HO, Edwards AFB, California. n.d., unpaginated.

Muroc Army Air Base by the Santa Fe Railroad and embankment, is assigned to, and under the jurisdiction of, the Commanding General, Materiel Command, for the conductance of special and highly classified experimental aircraft projects."⁵¹ The railroad created an important cultural and physical boundary for the Army.

Due to security requirements, the Muroc Flight Test Base was located approximately seven miles north of Muroc AAB on the northwest shore. The location is ideal for masking a secret facility.

Muroc Flight Test Base, World War II, and Bell's XP-59A Airacomet

In mid-1942, an additional unit was established at Muroc, the Muroc Flight Test Base, under the auspices of Materiel Command, Wright Field, Dayton, Ohio. The Base's creation was acknowledged on 10 December 1942 in a letter stating that "it is requested that action be taken to assign to the Materiel Command as a station, the North West portion of Muroc Air Base Reservation, which portion has been previously been allocated to the Materiel Command for flight test purposes and which has been fenced off and organized as the Materiel Center Flight Test Base."⁵² The Materiel Center Flight Test Base became the Materiel Command Flight Test Base, and later the Muroc Flight Test Base.⁵³

War and technological advances in weapons systems are social factors that directly influence site planning and facility

⁵¹. F.O. Carroll, Brigadier General to Buildings & Grounds Section, June 10, 1943; "Construction for Material Command Flight Test Base, Muroc, California"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

⁵². Robert W. Harper, Colonel, G.S.C., to Lt. Col. G.E. Sisco, Asst Chief of Air Staff, December 10, 1942; "Assignment of Portion of Muroc Air Base Reservation to the Materiel Command as a Separate Station"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁵³. Dodd, Malcolm J. "The Materiel Command Flight Test Base." Manuscript on file, AFFTC/HO, Edwards AFB, California, 1944, unpaginated.

creation on military bases.⁵⁴ These factors drove the establishment of the Muroc Flight Test Base and its unique cultural landscape. The Muroc Flight Test Base (modern North Base) was originally built to house and test fly Bell's XP-59A Airacomet. It was a secret jet airplane project which was deemed vitally important to the war effort. The Base was originally scheduled only to test the XP-59A. However, the success of the XP-59A brought more flight test programs to the Muroc Flight Test Base. It continued in that role throughout the 1940s and 1950s.

The Army viewed the development of jet aircraft as a necessary strategic advantage. When the XP-59A arrived in mid-September 1942, on a train from Buffalo, New York, the Muroc Flight Test Base consisted of a hangar and a barrack at the end of a dirt road out in the middle of the hot, windy, dry Mojave Desert.

The XP-59A airframe and engine were transported separately to Muroc Flight Test Base in September 1942. The components were heavily guarded and kept secret. By the time the engine and airframe arrived at Muroc Flight Test Base, the Army had designated the plane the XP-59A Airacomet; the XP-59 designation was chosen in order that the jet project could be viewed as an extension of an earlier Bell project, which was a single engine, dual pusher propeller aircraft canceled in 1941.⁵⁵ In fact, a fake propeller was placed on the plane when it was outside the hangar to maintain secrecy during World War II, and fuel trucks shielded the XP-59A from view during engine tests.⁵⁶

The Army had a hangar and a frame, two-story barrack assembled in anticipation of the arrival of the airframe and engine. Captain Malcolm J. "Joe" Dodd, in 1944, noted that the hangar was a Unicon "...portable type...The Muroc hangar had been shipped around the country four or five times and many of the parts were found to be missing."⁵⁷ The barrack, known as the Desert Rat Hotel, was a standardized Bachelors' Officers Quarters

⁵⁴. Kreger, 14-5,

⁵⁵. Carpenter, 14.

⁵⁶. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Personal Account #4. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

⁵⁷. Dodd.

(BOQ)-40. The barrack was 30 x 136 feet and no longer stands.⁵⁸

The new Base was originally planned as a temporary facility. The hangar was constructed with the opening facing the dry lakebed, since it was used as the runway for takeoffs and landings. Except for some wiring work and permanent hangar doors, the structures were complete when the Bell employees arrived on 18 September 1942. To maintain secrecy, the civilian contractor (C. J. Paradis) that built the Base were removed from the site the following day. The remaining work was completed by available servicemen and Bell employees.⁵⁹ A minimum of construction was ordered. In addition to the two buildings, a well and water tank, an access road, a guard shack, a sewage system, and extension of electric power were granted to the new Base. World War II Muroc Flight Test Base personnel were mainly aircraft people, mechanics (auto and aircraft), flight test engineers, instrumentation specialists, pilots, security police, cooks, secretaries, and administrators.

The plane was ready to be flown within a couple of weeks of its arrival. Bob Stanley, a Bell flight test pilot, conducted ground tests on the plane for the first time on 30 September 1942. The XP-59A first flew on 1 October 1942. Stanley took the new jet on three separate cautious flights, designed to "feel-out" the aircraft. On 2 October 1942, Colonel Laurence C. Craigie flew the jet, becoming the first American military pilot to fly a jet plane. Craigie's flight is considered the first "official" flight of the XP-59A. The flight was observed by visitors from the Navy Bureau of Aeronautics, NACA, RAF, Bell, GE, and the Army.⁶⁰ The next few months saw numerous tests, experiments, and alterations to the XP-59A, as Bell and the Army

⁵⁸. L. P. Whiten, Colonel, Air Corps to The Chief of Engineers; "Material Test Site near Muroc Dry Lake, California, April 13, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁵⁹. Thomson, Donald G. Personal Communication with Scott M. Hudlow, John Terreo, Skip Stagg, and Bob Mulcahy regarding North Base, 1994a.

⁶⁰. Document explaining procedure followed in setting up the base. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

Air Corps explored the new craft's capabilities.⁶¹ The success of the XP-59A and jet propulsion was not widely known. The XP-59A was not made public until 1944, even in military circles it was not widely known. A biennial report written in early 1943, discussed the success of the development of the B-29 and the B-32, the evolution of the flying wing designs, and the tailless fighter, but did not mention the first American jet aircraft.⁶²

The straight-winged XP-59A had a wide 45'6" wingspan; as a result, the small jet engines could not produce enough thrust. The flight speed of the XP-59A was quite low, top speed was only 415 mph (miles per hour)-- the aircraft was severely underpowered.⁶³ The new jet, in fact, was outperformed by older, propeller driven P-47 Thunderbolts and P-38 Lightnings in combat trials. Three additional XP-59A's and 15 YP-59A's were built before the XP-59A project was over. The XP-59A was similar in design (except the engine) to the earlier fighters, and was designed primarily as a "test bed" for future jet aircraft.⁶⁴

Yet, the XP-59A was put into production late in the War. The conclusion of World War II in 1945 quickly ceased the production line. A total of fifty P-59A's and P-59B's were built.⁶⁵ Although the P-59 has lapsed into obscurity in comparison to other more heralded aircraft, the plane's and the Base's importance was not lost on many of the enlisted personnel who served at the Base during World War II. A technical sergeant stated: "I believe that this base has advanced aviation about 10 years. Where else would these companies (Bell and G.E.) have had the opportunity or the backing to run these tests and conduct

⁶¹. Hallion, 168-171.

⁶². Draft for Biennial Report of the Army Air Forces, July 1, 1941 to June 30, 1943. Prepared by Assistant Chief of the Air Staff, Intelligence, Historical Division, May 5, 1943. H. H. Arnold Collection. Military Report. Box 183, Folder 7, Manuscripts Division. Library of Congress, Washington, D.C.

⁶³. Walker and Wickam, 255.

⁶⁴. Carpenter, 21.

⁶⁵. Foss, Richard L. and Roy Blay. "From Propellers to Jets in Fighter Aircraft Design." Lockheed Horizons Issue 23 (1987), pg. 19.

these experiments? G.E. would still be making light bulbs."⁶⁶

Late World War II: The Muroc Flight Test Base's Importance After the XP-59A

The Muroc Flight Test Base was ascribed permanence and importance, due to the significance and success of the XP-59A project. Permanence underscored a small but significant problem, the proliferation of the Muroc name. The personnel assigned to the Flight Test Base, asked that the name be changed to Ritchie Flight Test Base, to honor Perry J. Ritchie, a noted test pilot, and alleviate problems confusing the Muroc Flight Test Base with Muroc Army Air Field (AAF). Mail, telegrams, correspondence, and publications were often diverted to Muroc AAF, which caused delays.⁶⁷ The name change was never adopted, possibly since it was perceived that the bases would merge later. The Muroc Flight Test Base continued to test new planes on the north side of the dry lake after the XP-59A project was completed. The success of the XP-59A flight test program and the new flight test programs translated into additional construction projects. Two additional standardized hangars were built in 1943, one of which was GE's engine repair facility.⁶⁸ Additional construction activity continued at Muroc Flight Test Base between 1943 and 1945, which included barracks, a mess hall, and maintenance shops. The Base's heyday was during this period; upwards of 400 personnel were stationed at the Base in the mid-1940s. However, the personnel were not always housed at Muroc Flight Test Base, due to its small size.

Jake Superata, a Northrop mechanic, relates that Northrop personnel came and went as necessary. When he worked on the MX-324 project he stayed:

⁶⁶. Personal Account #1. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

⁶⁷. Tom M. Plank, 1st Lt., Air Corps, Commanding to Commanding General, Materiel Command, Wright Field, Dayton, Ohio; "Change in Name of the Materiel Command Flight Test Base, 6 June 1944"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

⁶⁸. Thomson, Donald G. Interview by John Terreo and Scott M. Hudlow on April 20, 1994, at Edwards AFB, California. Transcript of interview (NBOH-3) on file, AFFTC/EM, Edwards AFB, California, 1994b, pg. 3.

...in Mojave. For this reason, the crew that we had - we had quite a few people at the time. They would come and go. If we needed a job done fast or repair work, why, we would bring in a few more people. We would go down there and stay down there at White's Motel (which still stands).⁶⁹

Mojave was "the liveliest town in those days... [It] had a poker parlor and a motel."⁷⁰

The Muroc Flight Test Base also consistently tested aircraft on the cutting edge of technology, most of the planes exhibiting some "first" such as first American jet (XP-59A), first American jet bomber (XB-43), first American rocket-powered aircraft (MX-324/334), and an early flying wing (XP-79B).

The Muroc Flight Test Base was heavily guarded during World War II. A security perimeter ensconced the entire operational area; it encompassed the entire lakebed north of the AT&SF railroad tracks. Guard shacks were placed around the Muroc Flight Test Base, even on the lakebed.⁷¹ The Muroc Flight Test Base was so secret during World War II that outside personnel were not allowed on the Base. Even personnel from Muroc AAB were forbidden to enter Muroc Flight Test Base in the early years; most Muroc AAB personnel did not know why the Muroc Flight Test Base had been built until the XP-59A's existence was revealed in mid-1944. The servicemen and contractors stationed on the Base carried out all Base responsibilities, including fire suppression, rescue, maintenance, and auto/airplane repair.⁷²

Security mandates dictated that the Base be secured with "...a 3-strand barbed wire fence, approximately ten (10) miles in length, surrounding the Materiel Center Test Site, Muroc Lake,

⁶⁹. Superata, Jake. Interview by John Terreo on April 27, 1994 at Lancaster, California, pp. 7-8. Transcript of interview (NBOH-6) on file, AFFTC/EM, Edwards AFB, California.

⁷⁰. Brewer, Paul. Interview by John Terreo on May 25, 1993 at Edwards AFB, California, pg. 15. Transcript of interview (OH-4) on file at AFFTC/EM, Edwards AFB, California.

⁷¹. Thomson, 1994b:22.

⁷². Thomson, 1994a.

California."⁷³ The fence, according to then Colonel Franklin O. Carroll "...will increase the effectiveness of security measures and will afford a desirable and necessary boundary line between that portion of the Lake allocated to the Government and that which has been allotted to those civilian personnel."⁷⁴ Civilians were mining the lakebed playa; the clay was utilized as a lubricant for drill rigs.

Security fences are intrinsic to military site planning. Kreger notes "The military's perceived need to isolate and separate themselves from the surrounding community, and the compulsion to express, in the landscape, the presence of authority are also considered basic planning criteria... At Air Force bases, these ideals are expressed in the built environment by...surrounding bases with barbed-wire fences and controlled-access gates."⁷⁵

A no-fly zone was also established over the northern third of the lakebed. Lieutenant Colonel C. F. Cornish, from the Office of Flying Safety, dictated that pilots should "Avoid flying over N[orth] area of dry lake between railroad and highway. If flying over this area cannot be avoided, fly parallel to R.R. track and maintain a minimum alt. of 2000'."⁷⁶ The Office of Flying Safety stated the area was dangerous, and as such "flights into this Danger Area are not to be conducted without a specific authority of the Commanding Officer, Muroc Lake Army Air Base, proper control of flights so as to avoid

⁷³. James C. Shively, Colonel, Army Air Forces to Chief of Engineers; "Materiel Center Test Site, Muroc Lake, California, June 27, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁷⁴. F.O. Carroll, Colonel, Air Corps, to Commanding General, Air Materiel Command, Washington, D.C., Attn: Colonel Chidlaw; "Increase in Authorization Funds for the Materiel Center Test Site, Muroc Bombing Range, May 30, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁷⁵. Kreger, 18.

⁷⁶. C.F. Cornish, Lt. Colonel, Air Corps, to Commanding Officer, Muroc Army Air Base, Muroc, California; "Restrictions to Flight in Vicinity Muroc AAB, May 27, 1944"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

areas in question should be possible by means of proper instructions to locally based pilots and to transient aircraft cleared for flights through this area."⁷⁷

As testing continued at Muroc Flight Test Base during late World War II, a variety of contractors moved into the hangars. Northrop, Lockheed, North American, Curtiss-Wright, Consolidated Vultee (Convair), and Douglas had a presence at the Muroc Flight Test Base complex in the mid to late 1940s. These companies either had their own hangar or a shared space in a larger hangar.⁷⁸ A foreign aircraft company even had a temporary presence at the Muroc Flight Test Base in the mid-1940s. The British jet, the Gloster Meteor, whose engine was the model for GE's I-A engine which powered the XP-59A, was test flown out of Muroc Flight Test Base in late 1944, as a part of an exchange program between the U.S. and Great Britain.

Meanwhile, a German jet plane, the Me.262 *Sturmvogel*, designed by Prof. Dr. Ing. W. Messerschmitt and manufactured by the Messerschmitt Company greatly alarmed American top brass during bombing raids of Axis installations in 1943 and 1944. The Me.262's 550 mph level airspeed was faster than any allied fighter, and in many cases it was more maneuverable than Allied fighters. The Me.262 was the world's first true operational jet fighter.⁷⁹ In response, the Army Air Corps contracted with the Lockheed company to build a jet fighter that could actually be brought into production and combat, since the XP-59A was an operational disappointment. Lockheed's chief engineer, Clarence "Kelly" Johnson organized a group of engineers to work on the project and to meet an extremely short deadline. The "Skunk Works," as Johnson's team was called, created the XP-80 *Shooting Star* in 139 days, starting in June 1943.⁸⁰ Lockheed's engine

⁷⁷. C.F. Cornish, Lt. Colonel, Air Corps, to Commanding Officer, Muroc Army Air Base, Muroc, California; "Restrictions to Flight in Vicinity Muroc AAB, May 27, 1944"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

⁷⁸. Thomson 1994b:3-4.

⁷⁹. Memorandum on a Conference between Mr. Lawrence D. Bell of Buffalo, N. Y. and Dr. Ing. Geo. H. Madelung of Stuttgart. H. H. Arnold Collection. General Correspondence. Box 4, Folder 11. Manuscripts Division. Library of Congress, Washington, D.C.; Angelucci, 1983:238-39.

⁸⁰. Foss and Blay, 19.

designs were based upon the British Gloster H.1 Goblin jet engine. In November 1943, the plane was ready for actual flight testing, and was then taken to Muroc Flight Test Base.⁸¹ The air intakes collapsed the first time the jet engine was started delaying the program two months.

The XP-80 program continued the expansion of the Base's flight test role in the late war years. The XP-80 *Shooting Star* nicknamed "Lulu Belle" was first flown by Milo Burcham, a Lockheed test pilot, in January 1944, after the air intakes were repaired.⁸² Tony LeVier, a Lockheed test pilot, first flew the larger XP-80A *Shooting Star*, which had an improved power plant, the GE I-40, from the Muroc Flight Test Base in June 1944.⁸³ The jet plane did not serve any combat role in World War II, but it did become America's first, post-World War II, operational, production jet fighter. It served as the basis for many future jets. The Army's expectations for jet flight were partially based upon an increase in speed.

Post-World War II: New Plane Types and North Base's Role

As far back as 1929, Jack Northrop was considered an innovative aircraft designer. While he worked for Donald Douglas, Northrop kept his "wild" ideas for flying wings and other unusual aircraft secondary to more traditional models.⁸⁴ After Northrop split from Douglas in 1938, he was better able to pursue his "wild" designs. Northrop envisioned a plane without a fuselage or tail and with better overall aerodynamics; basically a flying wing. The earliest working model flew in July 1940. This concept demonstrator was called the N-1M Jeep but it proved to be unreliable.⁸⁵ Interest in the flying wing was reawakened during the war; Northrop earned a contract with the Army Air Corps to deliver a flying wing prototype. Northrop's first response was a rocket-propelled flying wing. The Army Air Corps designated the concept demonstrator; the MX-324. It was constructed of a welded chrome-moly steel tubing center section

⁸¹. Foss and Blay, 18.

⁸². Foss and Blay, 22-3.

⁸³. Walker and Wickam, 255.

⁸⁴. Biddle, 193.

⁸⁵. Hallion, 167.

and a plywood outer skin, spars, panels and bulkhead.⁸⁶

The MX-324 flight tests occurred at the Muroc Flight Test Base in 1943 and 1944. Jake Superata, a Northrop mechanic, described the MX-324 as:

...an airplane that looked like an airplane in a way, just the wing, and it was built very, very low to the ground. The leading edge would come right to your knee as you were standing by it. It was right down on the ground. There was a small landing gear. They wanted to keep it as low as they could. I don't know what they had in mind, but it wasn't raised up at all.⁸⁷

The pilot laid prone in the MX-324, straddling the fuel tanks. Superata relates:

He's laying down, okay, and has his chin on a chinrest. We called it that because there was nothing to hold your head as you were laying down. The stick was over here. His feet were in two pedal deals, like this for the controls on the trailing edge. That's about it. The two fuel tanks, one on one side and one on the other. They were plumbed in so, when they both got together, they go right through to the rocket engine and exhausted right on out.⁸⁸

The MX-324 was a dangerous aircraft. Don Thomson, a World War II Bell employee, states that "the... [MX-324] inverted and went into a spin, and he [Harry Crosby] couldn't get it out, so he bailed out, and the airplane righted itself and came in, I think upside down."⁸⁹

In 1943, Northrop developed a pursuit plane, XP-79B, from the MX-324 designed to shear the tail section off enemy planes with a magnesium reinforced wing. The Army soon granted a contract to Northrop to build the prototype aircraft based on the rocket-propelled MX-324. The XP-79B *Flying Ram* was finally completed in the summer of 1945. The project was slow in development due to mishaps and other higher priority projects

⁸⁶. Matthews, Henry. *Chronology of the MX-324: America's First Rocket Airplane*. Beirut, Lebanon: HDM Publications, 1995:8.

⁸⁷. Superata, 15.

⁸⁸. Superata, 8-9.

⁸⁹. Thomson, 1994b:17.

related to the war, but the plane finally flew on 12 September 1945.⁹⁰ Its test flight was conducted at Muroc Flight Test Base. The XP-79B, piloted by famed pilot Harry Crosby, went out of control and crashed. The crash was the project's and pilot's demise.⁹¹

The Muroc Flight Test Base, and Muroc as a whole, was the preeminent flight test center in the late 1940s. As such, on 14 October 1946, the Muroc Flight Test Base was designated a flight test center, officially recognizing a practice that had been going on for four years.⁹² Aircraft research began to center completely around Muroc after World War II.⁹³ The Base was so active and prominent in testing new jet aircraft that other military branches occasionally brought their planes to Muroc to be tested. Late in 1946, the Navy had North American Aviation's XFJ-1 Fury at Muroc AAF. It arrived soon thereafter at Muroc Flight Test Base later in 1946 when hangar space became available.⁹⁴ The Base continued in the postwar years to house many classified projects, much as it had during the war years; little information regarding these projects reached the outside world.

The year 1947 was a watershed year for the entire Base and its tenants. In September 1947, the National Security Act established the Air Force as a separate military branch.⁹⁵ The Air Force was now on equal standing with the other armed forces,

⁹⁰. Matthews, 28-29.

⁹¹. Morales, Joe. "Northrop's XP-79 - America's Third Jet." *Aerotech News and Review: Journal of Aerospace and Defense Industry News* 7, no. 14 (1991a), pg. 1.

⁹². "Designation of Muroc Flight Test Base as a Flight Test Center, October 14, 1946"; General Correspondence, Headquarters United States Air Force, Office of the Assistant Chief of Staff, Installations, Muroc Air Force Base, Record Group 341, National Archives, Washington, D.C.

⁹³. Hallion, 197.

⁹⁴. Brewer, Paul. Interview by John Terreo on April 20, 1994 at Edwards AFB, California, pg. 7. Transcript of interview (NBOH-4) on file at AFFTC/EM, Edwards AFB, California.

⁹⁵. Kreger, 12.

and largely replaced the Army Air Corps.⁹⁶ By 1947, a larger number of planes than ever before came to Muroc AAF to be tested, including the F-86 Sabre and the B-45 Tornado at the Muroc Flight Test Base.⁹⁷ Among these was the Bell X-1, the first plane to break the sound barrier in level flight, doing so on 14 October 1947 (from Muroc AAF, not Muroc Flight Test Base, however). NACA also became a permanent tenant of Muroc AAF at its high speed flight research station in 1947.⁹⁸

The Allies, during World War II, captured a number of German fighter planes and German aircraft-related technical data. The planes and data were examined by the Army Air Corps, not only to better understand the enemy, but also to gain insights into aircraft design. Many of these studies went toward the development of postwar aircraft. The F-86 Sabre, built by North American Aviation, owes its existence largely to these studies.⁹⁹ The Sabre utilized a swept wing design largely derived from captured German data and aircraft. Its wings were pulled back from a position perpendicular to the fuselage; it was different from any American plane before it. The F-86 was test flown at Muroc Flight Test Base beginning October 1947, and was the aerial hero of the Korean War. The F-86 shot down approximately 10 Soviet made MiG-15 Fagot's to each downed Sabre. The Sabre was a consistent fighter plane. The F-86 broke the sound barrier by 1948; supersonic flight was brought into the commonplace.¹⁰⁰

The F-86 flight testing (most of it done at Muroc Flight Test Base), represented a different kind of flight test from the early 1940s when the dominant flight test concept was "Fix-it-in-

⁹⁶. Hallion, 201-204.

⁹⁷. Brewer, 1994:7.

⁹⁸. Cattani, James P. *A History of Edwards Flight Test Research Centers and of Its Experimental Flight Programs*. Published privately, 1978:1.

⁹⁹. Bilstein, 180.

¹⁰⁰. Morales, Joe. "Approaching the Sound Barrier-The First Test Planes of Muroc." *Aerotech News and Review: Journal of Aerospace and Defense Industry News* 7, no. 14, (1991b) pg. 1.

the field" to facilitate production of combat-ready aircraft.¹⁰¹ In the late 1940s, the program for evaluating a new plane was becoming a regulated, scientific process.¹⁰² Phase I was contractor testing that included ground tests, taxi tests, first flights, and initial demonstration flights. Phase II flight testing was the responsibility of the U.S. Air Force. The military personnel determined if the plane met contractual obligations and design specifications, and decided if the aircraft warranted further development and future production. Phase III by the contractor was testing designed to "assess modifications made to correct deficiencies noted" during the Phase II testing.¹⁰³ Phase IV testing usually began with a production model of the aircraft and was designed to test all aspects of the plane's performance and operating characteristics.¹⁰⁴ The F-86 necessitated increased security at Muroc Flight Test Base. Although many projects were secret, security was increased after an aircraft reached or exceeded Mach 1.¹⁰⁵

By the end of the 1940s, the Muroc Flight Test Base was known as North Base and was extremely busy. A variety of contractors were present at North Base; many contractors had a number of ongoing projects progressing at the same time. Although the Muroc Flight Test Base coordinated with Muroc AAF during the 1940s, it was an independent Base until 1947 with no restrictions or centralized control. A majority of North Base's personnel in the late 1940s were contractor employees. Despite the vast amount of flight activity going on at North Base during this time period, crews were much smaller for individual planes than today. The personnel necessary for today's complicated, computerized aircraft were not needed during the 1940s.

Following the successful application of jet power to fighter/pursuit planes during World War II, steps were taken to use jet engines in bomber aircraft. However, once again, Germany beat the U.S. to the punch. The Arado Ar.234B-2 *Blitz* jet bomber

¹⁰¹. Van Pelt, Larry G. "The Evolution of Flight Test Concepts." Manuscript on file, AFFTC/HO, Edwards AFB, California, 1982:3.

¹⁰². Thomson, 1994b:8.

¹⁰³. Van Pelt, 6.

¹⁰⁴. Van Pelt, 6.

¹⁰⁵. Brewer, 1994:9.

first flew in 1943, several years before the B-45 Tornado.¹⁰⁶ Other American aircraft companies produced jet bombers before the Tornado; however, none reached production status.

North Base once again played a leading role. The earliest American jet bomber was the Douglas XB-43 *Versatile II*, which was present at the Base by May 1946. Another jet bomber tested at North Base was Convair's XB-46. The XB-46 was an advanced and graceful airplane; it was the first aircraft to use pneumatics instead of hydraulics in the landing gear. The XB-46 eventually lost out to the B-45 Tornado.¹⁰⁷

North American Aviation developed a jet-powered bomber, XB-45 Tornado at its Los Angeles factory, and brought it to its North Base hangar in 1947. The XB-45 Tornado became the first American multi-jet engine production bomber. The Tornado program was housed in Building 4505 in 1947. The B-45 served in a variety of roles during the late 1940s and early 1950s, including reconnaissance.

Northrop's flying wings continued being developed into the late 1940s, this time as a bomber. The YB-49 *Flying Wing* was first flown on 21 October 1947; however, many of the earlier problems continued. The plane was difficult to fly, and it was not capable of delivering bombs accurately. On a test flight on 5 June 1948, the second YB-49 during Phase II testing went out of control and crashed. The entire crew was killed. The test pilot was Captain Glen Edwards; less than 2 years later Muroc AFB was renamed Edwards AFB in his honor. This crash set back the flying wing idea considerably, although the program was probably already slated for cancellation. The flying wing in the late 1940s, in many people's view, needed more research to become an effective aircraft. The Air Force canceled the YB-49 program in 1949.¹⁰⁸ The flying wing idea was not fully utilized until the modern development of the B-2 *Spirit* stealth bomber.

The late 1940s witnessed the full-fledged development of what President Dwight D. Eisenhower termed the "military-industrial complex." Many people perceived a need for a strong and permanent military that could stand up to the threat of

¹⁰⁶. Angelucci, 1983:270; Angelucci, Enzo. *Airplanes: From the Dawn of Flight to the Present Day*. New York, New York: McGraw-Hill Book Company, 1971:116.

¹⁰⁷. Thomson, 1994b:8-9, 13.

¹⁰⁸. Brewer 1994:14-15.

foreign enemies. The military, to achieve this end, wedded itself to the country's aerospace industry to keep the country properly armed. The Air Policy Board, created by President Truman in July 1947, called for the constant production and supply of weapons and material to successfully wage war at any time. No longer, according to many Government/military officials, should the country mobilize just in wartime. The U.S. should be ready at all times. The Air Policy Board summarized this feeling by stating "This country, if it is to have even relative security, must be ready for war. Moreover it must be not for World War II, but World War III." General Arnold from the old Army Air Corps agreed completely "...in the visible future [security] will rest on our ability to take immediate offensive action with overwhelming force." Due to this growing sentiment for advanced weapons systems, Air Force and Navy aviation each got a substantial funding boost.¹⁰⁹

President Eisenhower warned against the development of this complex in which industry would become too dependant on Government contracts. Eisenhower believed this process would create, as it indeed already had, a technological, engineering elite that would replace the university and the private entrepreneur as the country's innovators. The country, in turn, would lose much of its democratic aspects, as technology would be controlled by large industry and the Federal Government.¹¹⁰ Indeed by the end of the 1940s, the military-industrial complex had largely replaced the individual shop room floor mechanic from the early part of the century. By the 1950s, large companies, such as Douglas, Boeing, Lockheed, and North American Aviation completely supplanted individual researchers like the Wright brothers, Glenn L. Martin, and Glenn Curtiss.

The 1950s, 1960s and the Cold War: Decline of North Base and Introduction of a New Air Strategy

The F-100 *Super Sabre* and the other members of the highly touted "Century Series"¹¹¹ were much more sophisticated aircraft

¹⁰⁹. Biddle, 295-297.

¹¹⁰. Eisenhower, Dwight D. "The Military-Industrial Complex" reprinted in *A History of Our Time: Readings on Postwar America*. William H. Chafe and Harvard Sitkoff, eds. New York, New York: Oxford University Press, 1983:108-111.

¹¹¹. The "Century Series" were the first generation of supersonic aircraft that had numbers starting with "100", such as the F-100, F-101, F-102, F-104, and F-106.

than their earlier counterparts and represented a new breed of jet aircraft. The flight testing of these advanced planes required more extensive and detailed evaluations. The fighters built in the 1950s could not be tested in the same manner as the propeller-driven fighters of World War I and II. The newer planes took longer to test and required a larger number of technicians and support personnel.¹¹²

Not only did airplanes become more complicated, but as Cold War tactics changed, so too did the kinds of planes and their associated missions. Air Force strategy in the late 1940s was geared towards enabling the U.S. to effectively counter Soviet aggression, particularly in overrunning western Europe. This strategy called for the ability to deliver massive amounts of ordnance, both conventional and nuclear, in a limited time period. This type of warfare called for large numbers of bombers, and a smaller number of escort fighters to counteract the enemy's fighters. This tactic was exemplified by "penetration fighters" such as Lockheed's F-90, McDonnell's F-88, or North American Aviation's YF-93 which had strike capabilities to reach targets deep into enemy territory. However, none of these planes went into production. The Korean War, instead, introduced the reality of a limited war, a war fought on a small, regional scale, without nuclear weapons. A majority of the aircraft of the 1950s reflect this change in Cold War strategy.

In direct opposition to the fighters of World War II and the immediate postwar years which were fast, small, and maneuverable aircraft, such as the P-51 *Mustang* or the F-86 *Sabre*, the newer 1950s jets were larger, heavier, more expensive, and more sophisticated. These jets were designed to function in limited war situations, while the earlier fighters were designed to intercept other fighters and bombers in a total war. These newer aircraft were designed to counteract perceived Soviet threats and to meet changing mission goals and concepts. The 1950s jets were designed to support ground troops, intercept other fighters, and if needed, deliver nuclear weapons.

The F-100 *Super Sabre* represented this new kind of aircraft. North American Aviation won the contract to build this fighter in early 1952. The fear that the Soviets would have a supersonic successor to the MiG-15 *Fagot* created a sense of urgency and prompted the desire for an American supersonic fighter to be built quickly. The F-100 *Super Sabre* was completed in early 1953 and was tested at North Base beginning in May 1953. The plane

¹¹². Hallion, 204-210.

was the first production fighter to consistently fly supersonic speeds in level flight. The F-100 was given a new armament complete with Sidewinder missiles and two 1,000-pound bombs, along with new 20mm M-39 machine guns. The plane performed well; it served the Air Force until 1978.¹¹³

McDonnell's F-101 Voodoo was tested at North Base beginning in September 1954, after the F-100. It was housed in Building 4401.¹¹⁴ The F-101 Voodoo became a low-altitude, nuclear armed fighter, yet it was originally designed to be a strategic bomber escort. Its deployment was delayed until 1957; the F-101 Voodoo served the Air Force until 1966.¹¹⁵

Activity declined at North Base in the mid-1950s; many programs moved to Main Base as aircraft testing became a longer and slower process. North Base became a testing ground for new and unusual aircraft. In 1954, North Base saw the arrival of the Lockheed XFV-1 Pogo. The Navy desired an alternative to carrier-based fighters, and Lockheed and Convair were contracted separately to develop planes that could operate from cargo ship decks to a beachhead in a vertical takeoff mode. The XFV-1 Pogo was an early attempt at vertical takeoff and landing; it was flown first on 16 June 1954.¹¹⁶ The Pogo was never launched from a vertical position. It was tested with a primitive nonretractable landing gear and took off in a conventional, horizontal fashion.¹¹⁷ Don Thomson states "He [Herman Richard "Fish" Salmon, a Lockheed test pilot] would takeoff on the dolly there, then when he was in the air, he would traverse in the vertical mode."¹¹⁸

In its continual desire for faster, bigger, and more

¹¹³. Wagner, Ray. *American Combat Planes*. Garden City, New Jersey: Doubleday & Co., 1982:463-465.

¹¹⁴. Edwards AFB Real Estate Records. Edwards AFB, California. Real Estate Records of individual structures at North Base. Records on file at AFFTC/CE-RE (Real Estate), Edwards AFB, California.

¹¹⁵. Wagner, 465-466.

¹¹⁶. Lockheed Aircraft Corporation. "From War to Peace." *Lockheed Horizons*, Issue 12 (1983), pg. 47.

¹¹⁷. Wagner, 515.

¹¹⁸. Thomson, 1994b:17.

versatile jets, the Air Force tested a large number of planes in the post-Korean War years. New plane types abound in this period, many jets served for only a few years before becoming obsolete. This rapid evolution from project to project was amazingly swift when compared to the more immediate past. Many of the modern aircraft now serving in the U.S. Air Force have been around for 20 or more years, unlike their predecessors of the 1940s, 1950s, and 1960s. Perceptions of threats drove rapid technological change during the Cold War. The diverse aircraft developed at North Base are a tangible artifact of the Cold War, and evidence of its impact on the cultural landscape through the development of military aircraft. The aircraft and aircraft projects display the Cold War mentality and identity through their diverse forms and technological attributes. These aircraft were a tangible product of their planners, designers, pilots, military and civilian commanders, and the individual and corporate response to perceived Soviet threats. These weapons display the dark side of the Cold War, the actual manner in which Cold War goals were to be achieved if it escalated to actual fighting rather than a global chess match. North Base's role was to develop and test the weapons systems that would achieve these goals, including improved flight safety, aircraft performance, and national defense.

Although flight test activities at North Base declined in the 1950s and 1960s, important and top secret aircraft continued to be tested and operated at the Base. One of the most secretive programs operated at North Base was Lockheed's U-2. The U-2, which looked like a motorized glider, flew long-range photo reconnaissance missions and high altitude weather and environmental research. The highly maneuverable, unarmed U-2 flew at high altitude (between 70,000 and 90,000 feet) to conserve fuel, which lessened weight requirements, and to escape enemy aircraft and missiles.¹¹⁹ The U-2 had an extremely wide 79-foot wingspan, and was fitted with instrumentation designed to handle high-altitude flight extremes. It was first test flown by Tony LeVier on 1 August 1955; the U-2 averaged one flight per month over the Soviet Union before 1960.¹²⁰ These missions ceased after a U-2 was downed in 1960, yet the plane has continued to serve as an important reconnaissance tool in the subsequent decades.

¹¹⁹. van der Aart, Dick. *Aerial Espionage: Secret Intelligence Flights by East and West*. New York, New York: Arco/Prentice Hall Press, 1985:38.

¹²⁰. van der Aart, 29.

The U-2 first came to North Base in 1960, after Francis Gary Powers, a Lockheed pilot, was downed over Russia on 1 May 1960.¹²¹ All the Central Intelligence Agency's (CIA) U-2s from foreign Operating Locations arrived at North Base in 1960.¹²² While the U-2 fleet was quietly waiting for the political firestorm over the Powers incident to quell, Lockheed and the Air Force studied in-flight refueling techniques for the U-2 at North Base. Kelly Johnson noted that "We have developed in-flight refueling for the U-bird and can take aboard about 900 gallons from a KC-135."¹²³ Later in 1960, Lockheed and the Air Force succeeded in perfecting night refueling techniques at North Base.¹²⁴ Several U-2's were also assigned to Edwards AFB for flight test and research purposes during the early 1960s.

In 1965, Lockheed began to study new U-2 designs that would benefit from the new Pratt and Whitney J75 jet engine. This study produced the original designs for the U-2R: the bigger, stronger, second generation U-2.¹²⁵ The new engine gave some thrust increase. The wingspan grew to 103 feet, however, the airfoil remained unchanged. The larger wing provided increased fuel capacity, which gave the aircraft a range in excess of 3,000 miles. On 28 August 1967, following several days of static and taxi tests, the U-2R was flown from North Base for the first time. Jay Miller, aviation writer, quotes Clarence "Kelly" Johnson who stated that "At 7:58 a.m. Bill Park made the first flight in the U-2R. Schumacher and I chased him in a *Twin-Bonanza*. There was a good turnout of Headquarters and Air Force people. The aircraft flew well. A very successful day."¹²⁶

The second U-2R was deployed at North Base in 1968. The U-2R was accepted approximately one year after the initiation of the flight test program. The CIA operated the first six U-2R's. Two of the aircraft were assigned to North Base for training Air

¹²¹. van der Aart, 32.

¹²². Miller, Jay. *Lockheed's Skunk Works: The First Fifty Years*. Arlington, Texas: Aerofax, Inc., 1993:86.

¹²³. Miller, 86.

¹²⁴. Miller, 86.

¹²⁵. Miller, 89.

¹²⁶. Miller, 92.

Force and CIA pilots.¹²⁷ The U-2R was operational from 1969 to 1975 at North Base.

The U-2R project was ascribed great importance by the Air Force, which constructed an addition to one of the hangars to accommodate it at North Base in 1968. Security was increased at North Base for this classified project; North Base was chosen for the U-2R because of its isolation and because the previous U-2 unit had left the facility vacant, when it was reassigned to Davis-Monthan AFB, Arizona.

Project Senior Pace moved into the Base after the U-2R flight test program was complete. Five classified programs, involving three U-2's, composed Project Senior Pace. The Base contained an operational unit rather than a flight test operation for the first time in its then 25-year history. Senior Pace was an Air Force program, but the research was conducted for any customers that needed a high-altitude platform, including JPL (Jet Propulsion Laboratory) and possibly the CIA.¹²⁸ The Navy utilized two of North Base's U-2R's for conducting a ship tracking program in late 1972.¹²⁹ Although, the public learned about the U-2 after the Powers incident in 1960, it is still basically a classified project.¹³⁰ The project personnel were primarily military pilots and civilian maintenance workers.¹³¹

Site Characteristics

The climate at North Base is a mid-latitude desert type with hot, dry summers and cool, slightly moist winters. Average precipitation is less than 12.7 centimeters (5 inches) per year, with most occurring as rainfall during the winter months. Temperatures range between 38 and 43 degrees Celsius (100 and 110 Fahrenheit) in summer and drop to well below freezing in the winter. The climatological scheme dictates a reliance on subsurface water for permanent habitation.

¹²⁷. Miller, 92-3.

¹²⁸. Riedenauer, Robert L. (Lieutenant Colonel, USAF, Retired) Interview by Dana Kilanowski and Skip Stagg on April 22, 1994 at Lancaster, California, pg. 6. Transcript of interview (NBOH-5) on file, AFFTC/EM, Edwards AFB, California.

¹²⁹. Miller, 94.

¹³⁰. Thomson, 1994b:13-14.

¹³¹. Riedenauer, 9.

The Base occupies portions of the alluvial floors of several intermontane valleys in the western Mojave Desert. North Base is located between 1.5 and 10.7 meters (5 and 35 feet) below the prehistoric shoreline of Thompson Lake.¹³² Geologically, Edwards AFB (within which North Base is now included) is located within the geologic structure known as the Mojave Block, and is bounded by the Garlock and the San Andreas Fault zones. The faulting and uplift associated with the Mojave block have created a region which is geologically complex, with both Tertiary and Pre-Tertiary geologic formations as well as later Quaternary alluvial sediments. The Base is located in an area of recent Quaternary alluvium composed of alluvial sand and gravel, playa clay, and wave-deposited sandbars.¹³³

Botanically, North Base is located within the xerophytic phase saltbush scrub community. The major shrubs represented in the study area include allscale (*Atriplex polycarpa*), cheesebush (*Hymenoclea salsola*), golden cholla, (*Opuntia echinocarpa*), creosote bush (*Larrea divaricata* var. *tridentata*), boxthorn (*Lycium cooperii*), rice grass (*Oryzopsis hymenoides*), spinescale (*Atriplex spinifera*), and wolfberry (*Lycium andersonii*).¹³⁴

Architectural Evaluation

Muroc Flight Test Base was constructed between 1942 and 1945. Muroc Flight Test Base consisted of two primary sections, the mission support area and the community support area. The mission support area consisted of four hangars and related mission support buildings such as administration buildings, a control tower, a motor pool, workshop areas, and warehouses. The community support areas consisted of a theater/chapel, mess hall, officers' and enlisted men's barracks, lavatories, an infirmary, a recreation building, and a school. Sundry support buildings such as a guard shack, transformer buildings, firehouse, and water booster and suppression facilities served both the test facilities and the adjacent living area at the Muroc Flight Test

¹³². Dibblee, Thomas W. "Geology of the Rogers Lake and Kramer Quadrangles, California." USGS Bulletin 1089-B, U.S. Department of the Interior, Geological Survey (USDI-USGS), U.S. Government Printing Office, Washington D.C., 1960:127.

¹³³. Dibblee, 127.

¹³⁴. Vasek, Frank C. and Michael G. Barbour. "Mojave Desert Scrub Vegetation." In *Terrestrial Vegetation of California*. Michael G. Barbour and Jack Major, eds. New York, New York: John Wiley and Son, 1977, pp. 835-867.

Base. A variety of these landscape features and structures are still extant.

The Muroc Flight Test Base cultural landscape evolved quickly during World War II; the landscape changes peaked in 1945. The Base continued to expand after World War II, but on a limited scale, and adjacent to the World War II Base area. Planning decisions were reactionary and geared toward solving new temporary problems. The Base's World War II dynamism underscores the importance the U.S. Army ascribed to technological advances during World War II, and demonstrates how quickly technology and corresponding social and cultural changes occur. The cultural landscape of the Muroc Flight Test Base reflected the changing needs of the burgeoning military aerospace industry and the evolution of a modern research and development facility. The commonplace nature of the temporary construction belied the importance and the radical nature of the flight test work conducted at Muroc Flight Test Base during World War II.

Sites were chosen to house new buildings as needs were identified. A master plan was not present; these decisions were made on an individual, building-by-building basis. A U-shaped grid was developed that focused attention on the hangars and the lakebed. The grid delineates different functions; it segregates the mission support and the community support areas. The grid was split into eastern and western sections by the original North Base Road, which primarily accessed the four hangars. The last hangar and its support buildings were separated from the rest of the Muroc Flight Test Base by a T-shaped runway.

Taylor and Barnes, architects and engineers of Los Angeles, California, won the contract to build the Muroc Flight Test Base in 1942. The first bid to build the Base was too high; the Army Corps of Engineers let a second contract. Taylor and Barnes was one of four firms that responded.

Edward C. Taylor, the senior and principal member of the firm, had previously built hangars and industrial spaces for fabricating and testing aircraft. Taylor and Taylor (Edward C. Taylor's firm when he was worked with his brother, Ellis Wing Taylor) were "employed as architects and designers by Donald Douglas of Santa Monica on the original buildings of the latter's aircraft factory. Taylor...also planned later additions to the plant, now one of the largest and most important in the

country."¹³⁵

Taylor and Barnes planned and laid out the Muroc Flight Test Base between 1942 and 1945. They did not assist in the site planning; the military chose the Base's location. Taylor and Barnes did not design the structures, their role was less architect, than general building contractor. The structures are Series 700 and Series 800 temporary buildings, designed to be serviceable for five to seven years. The exact buildings, type, function, materials, size, and scale were mandated by the Army. John Garner, historian, states, "The design of military buildings, especially those constructed during periods of mobilization (such as World War II temporary buildings), was determined by operations of line units for training and field use."¹³⁶

Temporary construction was a hallmark of World War II stateside mobilization.¹³⁷ Muroc Flight Test Base was a temporary facility that was considered a cantonment during World War II. "A cantonment is a temporary garrison. Cantonments during World War II were designated as camps and forts. Their primary purpose was to provide training facilities for land, air, and naval operations, although some received special designation as munitions and testing sites."¹³⁸ The Army erected prefabricated buildings that had a temporary lifespan of 5 to 7 years. The Muroc Flight Test Base was unique as a cantonment in that it was a testing facility.

Dismantling was another important facet of temporary construction; often these buildings were dismantled because they were temporary and no longer considered necessary. The buildings were bolted to their poured-in-place concrete foundations. The bolts were undone and the buildings dismantled. Many of these

¹³⁵. Withey, Henry F. and Elsie Rathburn Withey, eds. *Biographical Dictionary of American Architects, (Deceased)*. Los Angeles, California: New Age Publishing Co., 1956; Southwest Builder and Contractor. "Edward C. Taylor Dies," *Southwest Builder and Contractor*. (February 1946), pg. 9.

¹³⁶. Garner, John S. *World War II Temporary Military Buildings: A Brief History of the Architecture and Planning of Cantonments and Training Stations in the United States*. USACERL Technical Report, CRC-93/01, Champaign, Illinois, 1993:19.

¹³⁷. Garner, 33-47.

¹³⁸. Garner, 59.

buildings were later sold. This process occurred in the late 1950s, after North Base declined in relative importance. The buildings that were still inhabited in the 1950s and 1960s were later destroyed around 1970; they were deliberately burned by the North Base firemen for fire fighting practice.

Muroc Flight Test Base was designed for maximum efficiency. Kreger notes that:

Utilitarianism...plays a role in shaping planned landscapes. It is characterized by the absence of waste. It is an uncomplicated, no frills, landscape management philosophy. It has, with few exceptions, been the hallmark of Air Force planning. It affects architectural design and styling standards, and serves to prohibit the construction of unnecessary and cost-prohibitive facilities which might be deemed luxurious.¹³⁹

Indeed, the Muroc Flight Test Base was small, compact, and had a minimum of construction. The Base only expanded when the mission expanded or changed its focus and new construction was necessary to meet the changing mission goals.

The Base's temporary architecture and cultural landscape reflected these needs and goals, and is marked by an uncomplicated landscape. A cultural landscape is the communal sum of the built environment, including vernacular architecture and the social and experiential webs that bind a community. Vernacular architecture and the cultural landscape are reflectors of conscious and unconscious ideas and concepts; they are historical products that reveal intent and define social and cultural relations. In a 1985 article, Dell Upton, architectural historian, stated "artifacts of every scale are physical expressions of the continuous articulation of space that we all carry in our heads, and we must attempt studies that acknowledge this by treating as many kinds and scales of objects as possible, and treating them in an integrated manner."¹⁴⁰ Integration of different types of artifacts can be achieved by studying the built environment as a holistic entity; a cultural landscape.

The term "cultural landscape" has arisen from cultural geography. It allows an investigator to integrate individual components of a community into a general context of related

¹³⁹. Kreger, 18.

¹⁴⁰. Upton, Dell. "Comment." *Material Culture*, Vol. 17 (1985), Nos. 2-3, pg. 85.

building types, time periods, and places. The cultural landscape reflects the way in which a place is the product of its own unique history, and how it has transformed over time; a cultural landscape is a growing and evolving entity.

The Muroc Flight Test Base was designed to be a secret facility to test experimental aircraft. The Base's focus was on the aircraft hangars and the adjacent Muroc Lake, since it was the flightline and runway for the aircraft until the current runway was constructed in 1943.

Taylor and Barnes and the Army Corps of Engineers designed the Base to satisfy two major construction requirements, ease and speed of construction. The cultural landscape, especially the utilization of temporary architecture, consciously and unconsciously reflects these ideas. They are imbedded in the Base's material culture, particularly in prefabricated building materials and units. The vernacular architecture of the Muroc Flight Test Base is a folk architecture based upon the constant repetition of building forms and types.¹⁴¹ It is this vernacular, folk nature of the Muroc Flight Test Base that makes it a powerful place, reflective of the essence of World War II military culture.

The design criteria embodied by the temporary architecture at the Muroc Flight Test Base were as follows:

Ease and speed of construction... Framing remained simple. Anticipated manpower shortages made it necessary to use unskilled labor. Only a portion of those employed on building crews would be experienced carpenters, so framing techniques were intentionally designed to be uncomplicated. Platform framing, in which floors are framed separately (as opposed to balloon framing), had been in practice since the turn of the century. Second-story floors obtained greater stability and load-bearing capacity. Dimensioned lumber and stock items such as doors and windows were used throughout. The concrete foundation piers of most company buildings were 8 x 8 in. posts of 5 ft height, set on 16 in. square concrete footings installed 3 ft below grade. Anchor bolts set in the middle of each pier fastened a composite sill made up of three 2 x 8s spiked together. The sills carried 2 x 8 joists that spanned 10 or 13 ft, depending on the

¹⁴¹. Vlach, John Michael. "The Concept of Community and Folklife Study." In *American Material Culture and Folklife: A Prologue and Dialogue*. Simon J. Bronner, ed. UMI Research Press: Ann Arbor, Michigan, 1985:63.

building.¹⁴²

Prefabrication was not new. It had become an important part of the building industry in the late 19th-century. Factories built different types of building materials, assembly-line window sash factories, as well as standardized building materials, particularly balloon-frame lumber.¹⁴³ Buildings were also built at one location and shipped by rail or water to diverse isolated places.¹⁴⁴ Despite its availability, prefabrication was not a common building technique until after World War II.

The U.S. military began using prefabricated building units in the early 20th century. To the extent that prefabrication was normally "used in the construction of U.S. military bases, it was in the use of prepared materials such as ready-cut lumber delivered to site, and in the assembly-line manner in which buildings were erected."¹⁴⁵ However, at the Muroc Flight Test Base, prefabrication also included buildings assembled at different locations and trucked to the site.

Furthermore, building standards were under development at the advent of World War II. John Garner states:

The only standards that had been established in the construction industry were those associated with the dimensions and grades of materials. On the other hand, municipal officials established codes for life-safety, based on minimum standards according to building use. Such codes varied between cities, and enforcement rarely extended to

¹⁴². Garner, 39.

¹⁴³. Bishir, Catherine, Carl Lounsbury, Charlotte Brown, and Ernest Wood III. *Architects and Builders in North Carolina: A History of the Practice of Building*. Chapel Hill, North Carolina: University of North Carolina Press, 1990:193-239.

¹⁴⁴. Stilgoe, John R. *Metropolitan Corridor: Railroads and the American Scene*. New Haven, Connecticut: Yale University Press, 1983:195-209; Hudlow, Scott M. and Anna L. Gray. *Phase II Architectural Evaluations of Structure 131-379, Wallace House, and Structure 131-380, Superintendent's House associated with the Proposed Route 17 Project, City of Chesapeake, Virginia*. William and Mary Center for Archaeological Research, Williamsburg, Virginia, 1992:27-40. Report on file, Virginia Department of Historic Resources, Richmond, Virginia.

¹⁴⁵. Garner, 14.

single-family residential construction. It was left to the military services to establish their own minimum standards. The least expensive material for framing and cladding, and hence the most widely used material for temporary construction, was dimensional lumber. Its use had been made possible by the advent of the rotary steam-power saw, which could cut lumber to precise dimensions, and the lumber yard, which acquired construction materials wholesale and became a fixture in every U.S. town with railroad service. Grades of lumber were specified by the lumber industries and their associations. The better the grade, the fewer the knots and checks, and hence the greater the strength. Iron structural shapes and galvanized sheeting had also been introduced to the building market during the 19th century for industrial, commercial, and residential use, but was used less extensively than lumber. Plywood, hardboard, and asbestos cement, introduced in the early 20th century, were still considered experimental as late as World War II, although the military services would employ large quantities of each. Thus, the materials and techniques used during periods of war were hardly revolutionary and, for the most part, had enjoyed a long history of peacetime development and application.¹⁴⁶

Temporary buildings were numerous and important intrinsic elements of the cultural landscape of World War II military installations. This was not a new building process. Temporary building types constructed during World War I had included barracks, warehouses, mess halls, etc., including airplane and dirigible hangars. The World War II hangars constructed at the Muroc Flight Test Base are similar in scale, scope, and material to the World War I hangars. John Garner writes that:

Hangars for the Army Signal Corps (later separated as the Army Air Corps) posed a new challenge. Although balloons and airplanes had been purchased before World War I, the first training facilities were not constructed until 1917. A timber-frame hangar, as a temporary building type for American camps, was designed by Albert Kahn, the well known and respected Detroit architect responsible for large-scale industrial plants required for automobile manufacturers--the Ford and Dodge plants in particular. These structures were introduced to airfields in 1917, but were replaced by permanent steel hangars of similar design the following year. The wooden hangars, with a gambrel-type roof, measured 66 x 122 ft, and could accommodate six and eight

¹⁴⁶. Garner, 15.

aircraft. Because of the need for clear spans, a modified Pratt truss with a lower chord made of 2 x 12s and the remaining web members (including diagonal and vertical bracing) of 2 x 8s, were framed in pairs and inserted into reveals in the top of 18 ft wall columns. The columns divided the hangar into 15 ft. bays, and each column was built up of four 2 x 12s. The two outer boards were separated from the inner and outer laminates of the columns, and anchored by U-bolts embedded in a 4 in. concrete slab that extended 3 ft beyond the walls of the hangar. Purlins of 2 x 8s placed 24 in. on center between the paired trusses tied the trusses together and carried the roof decking. The purlins were blocked solid in between on the lower pitch of the gambrel roof. The decking and exterior wall cladding was 7/8 in. shiplap siding, the roof portion covered with paper with a crushed-slate red aggregate finish. Six-part composite sash windows were employed one to a bay (or sixteen to a hangar). The doors were 18 ft high and attached to rails by grooved "Hyatt" rollers. So that the doors could open fully, 8 x 8 in. braced frames extended to carry the doors 16 ft beyond the side doors at the end of the hangar. Despite the temporary nature of the buildings, they were painted.¹⁴⁷

The temporary buildings at the Muroc Flight Test Base were simple, weatherboarded, balloon-frame structures. Each building had one story, except the hangars and the two-story officers quarters. The architecture was unified in size and scale; the buildings were primarily built on variations of 10- and 12-foot units. The structures rest on poured-in-place concrete foundations, and had simple gable roofs. However, the hangars have parabolic roofs and the water deluge building has a round roof with a centered lantern opening. Don Thomson states "They [the buildings] were all wood and then tar paper [roofs]."¹⁴⁸

The Base is organized on a modified U-plan that was the product of seven accretionary building campaigns between 1942 and 1945. The runway has a "T" form, the taxiway extends north from Muroc Dry Lake to the runway. The 6,000-foot runway extends east/west. The taxiway divides one of the hangars and its support buildings from the rest of the Base.

¹⁴⁷. Garner, 30.

¹⁴⁸. Thomson, 1994b:19.

First Building Campaign, 1942

The first building campaign began at the Muroc Flight Test Base in May 1942.¹⁴⁹ The earliest reference to the future test site was made in April 1942, when Colonel L.P. Whitten, Director of Base Services, ordered an "Officers Quarters, Type OQ-40, Plan 800-317, Size 30 feet by 136 feet" and a hangar. It was further noted that "This hangar was made by the Air Service Command and has been shipped to the Commanding Officer, Muroc Air Base for the Materiel Test Site."¹⁵⁰

Before the aircraft and personnel arrived at the Muroc Flight Test Base, arrangements were already underway to counteract windblown dust, which was perceived as a significant problem. The 1942 annual Base construction update stated:

Since the Air Base at Muroc, California is located in the Mojave Desert which is subject to terrific sandstorms at certain seasons of the year, the new construction activities at that base have not only disturbed the top soil, but with all the hauling and trucking the dust storms which blow through the camp work undue hardship on the personnel.¹⁵¹

The Army attempted to control dust in two basic manners: digging dust control ditches and oiling the roads. Dust was viewed as a health as well as a maintenance problem.

The Army and Marine Corps knew that *Coccidiomycosis* or "Valley Fever" was an earth-borne disease endemic to the southern San Joaquin Valley and that construction activity helped facilitate the spread of this often fatal disease. The Army suspended operations in the San Joaquin Valley, except airfield construction, in response to Valley Fever outbreaks during World

¹⁴⁹. Thomson, 1994b:3.

¹⁵⁰. L. P. Whitten, Colonel, Air Corps to The Chief of Engineers; "Material Test Site near Muroc Dry Lake, California, April 13, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

¹⁵¹. "Annual Base Construction Update, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

War II.¹⁵² In addition, the military thought Valley Fever was endemic to other portions of Kern County, including the Mojave Desert.¹⁵³

The Army developed several methods to control dust, including the construction of dust control ditches to trap and regulate it. These ditches also were used as drainage ditches, but this was not their main function. Their primary purpose was to control dust. 250,000 pounds of dust palliative was applied to the landscape after consideration of the damage done to experimental equipment from dust.¹⁵⁴

An extensive system of dust control ditches crisscross the Muroc Flight Test Base. The ditches not only follow the roads, but also cross the landscape in a haphazard fashion. Constructed on both north/south and east/west lines, the ditches were built in a variety of locations, including the housing area west of North Base Road, west of the flightline, and throughout the entire Muroc Flight Test Base area. The ditches were not built uniformly, but vary in both width and depth depending on the location. They varied between 5 and 12 feet in width, and between 1 and 4 feet in depth.

Another dust control method involved oiling roads to trap the dust before it became airborne. In August 1942, before the XP-59A arrived from Buffalo, "the Los Angeles District Engineer [was] directed to provide an oil penetration or oil mix road from the main highway to the Materiel Command Test Site at Muroc Lake, California, and around the hangar."¹⁵⁵

¹⁵². Koehler, Tamara. "Disease Alarmed Army in 40s after Vehicles Stirred up Dust." *Bakersfield Californian* 26 May 1994.

¹⁵³. Pfanner, Eugene F. "Coccidioidomycosis at U.S.M.C. Air Station, Mohave, California." *U.S. Naval Medical Bulletin* 46, no. 2 (February 1946): 229-236.

¹⁵⁴. W.L. Doolan, Jr., Colonel, Air Corps, Acting Adjutant General to Commanding General, Army Air Forces, Washington, D.C. Attention: Asst. C/AS-MMD, Construction Branch, Supply & Services Division; "Additional Construction Facilities for the Materiel Command Flight Test Base, Muroc, California, August 24, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁵⁵. Headquarters of the Army Air Forces, Washington to The Chief of Engineers; "Materiel Test Site, Muroc Lake, California, August 26, 1942"; Air Adjutant General, 1939-1942, Records of the

Initial Building at the Muroc Flight Test Base

The Bachelor Officers Quarters (BOQ) and the Unicon Portable Hangar were the only buildings standing at the Muroc Flight Test Base when the XP-59A arrived. C. J. Paradis built the BOQ and assembled the Unicon Portable Hangar.¹⁵⁶ The Unicon Portable Hangar was shipped to Muroc as a complete, (in pieces) temporary building from Air Service Command, Ogden, Utah. It is the Muroc Flight Test Base's oldest standing structure and one of the oldest aircraft hangars and most historic structures at Edwards AFB. The Unicon Portable Hangar housed the XP-59A when it arrived from Buffalo, New York, in September 1942.

The Unicon Portable Hangar (T-2 T=temporary, Building 4305) is a small multi-story aircraft hangar. It has dimensions of 135 x 160 feet. It rests on a poured-in-place concrete foundation, and has a parabolic concrete and tile roof resting on laminated, scarf-joined bents that traverse the width of the hangar. The roof is covered with concrete and ceramic tiles; banks of casement windows are located on the north and south facades. The hangar originally had a canvas covering on the east facade facing the lakebed. The covering was on the hangar until December 1943 when the current eight metal sliding doors were erected by the Weymouth Crowell Company.¹⁵⁷ Twenty-light casement windows light the sliding doors. The metal doors are hung on a external framework that allows the doors to slide open enabling aircraft to enter and leave the hangar. The hangar can house four to six aircraft depending on their size; it contains second-story workspaces on the west facade, including an instrumentation laboratory and storage space. The hangar has been altered, but not structurally. In 1977, NASA inserted an "office box" into the hangar to facilitate its use as office space. A myriad of support buildings have been attached to the hangar in recent years, including a one-story concrete block structure on the north facade that houses offices.

Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

¹⁵⁶. List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

¹⁵⁷. List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

In addition to the hangar, quarters were erected for the first personnel working at the Muroc Flight Test Base. The test base personnel were primarily contractors, initially Bell aircraft employees. The BOQ was scheduled to be a BOQ-40, plan number 800-317, however, a BOQ-36 was actually built.¹⁵⁸ The 800-Series buildings are typical World War II temporary construction.¹⁵⁹ Colloquially known as the Desert Rat Hotel, the BOQ did not have a messing facility when it was initially built. A mess hall was inserted into the quarters by the end of 1942.¹⁶⁰ In January 1943, this messing facility was financed and operated by Bell Aircraft at a price of \$2.50 per day, per man; however, the U.S. Army planned on having the military operate a mess hall in the future.¹⁶¹ A separate mess hall was built later for enlisted personnel, during the Base's first expansion in 1943.

The Desert Rat Hotel (T-1) was a 30' x 166', two-story, balloon-frame, weatherboarded, gable-roofed structure with a shed on the west facade. The Desert Rat Hotel rested on concrete piers; the roof was probably covered with a rolled asphalt covering. The shed on the west facade housed a workspace; the mess hall was probably also located at the west facade. The Desert Rat Hotel housed upward of 44 single and transient male

¹⁵⁸. James C. Shively, Col., Army Air Forces to The Chief of Engineers; "Construction for Materiel Test Site Near Muroc Dry Lake, California, July 29, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

¹⁵⁹. Garner, 33-47.

¹⁶⁰. James C. Shively, Col., Army Air Forces to The Chief of Engineers; "Construction for Materiel Test Site Near Muroc Dry Lake, California, July 29, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

¹⁶¹. Malcolm J. Dodd, 1st Lt., Air Corps, Officer in Charge to Colonel Ralph O. Brownfield, Commanding Officer, Wright Field, Dayton, Ohio; "477th Base Headquarters and Air Base Squadron, December 29, 1942"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

personnel who travelled home on the weekends¹⁶²; families primarily lived off-Base. Don Thomson lived in the Desert Rat Hotel in the early 1940s when he worked for Bell Aircraft as an instrumentation specialist. He describes it as a:

...wooden frame building, two-story. There was a little rec[reation] room at the east end of the main bottom floor, and then there was, of course, the kitchen and the messhall, or whatever you called it. It was a rather small one, at the west end. The rooms were dual occupant, or two people per room in a bunk bed arrangement and there were no closets. So what everybody more or less did was buy these cardboard closets that had flimsy doors on it to keep your clothes relatively clean and free of the dust and what have you. And of course you have your showers and lavatories. That was on the second floor.¹⁶³

The Desert Rat Hotel probably housed the people comprising the original contingent of military and Bell personnel that staffed the XP-59A project. A memo, dated 27 August 1942, requested that the Quartermaster furnish bedding for 65 individuals, including blankets, steel cots, mattresses and covers, comforters, folding chairs, and appropriate mess hall equipment.¹⁶⁴ Paul Brewer, a North American Aviation flight test engineer, stated that in 1947 approximately 100 people lived in the Desert Rat Hotel.¹⁶⁵ The Desert Rat Hotel is now beneath a parking lot.

The Desert Rat Hotel provided quarters for officers and private contractors such as Bell and North American Aviation. The enlisted men's quarters were separate, in keeping with the Army's policy of enforcing social segregation by having different barracks for enlisted men and officers. In this respect, the Muroc Flight Test Base was not different from other military

¹⁶². Muroc Flight Test Base, Unit History, 1 July - 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

¹⁶³. Thomson, 1994b:2.

¹⁶⁴. L.P. Whiten, Colonel, Air Corps, Director of Base Services to Commanding Officer, Army Air Base, Muroc, CA; "Issue of Equipment, August 27, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

¹⁶⁵. Brewer, 1994:12.

bases; social segregation was a universal U.S. military pattern. This decision is "...made and enforced with only one goal in mind: the successful completion of the military mission. Thus Air Force forms of segregation are inexorably rooted in the long standing belief that discipline is essential to mission success and discipline is best maintained when fraternization between persons of different status is minimized."¹⁶⁶ Enlisted men's barracks were built after the Base expanded in early 1943.

While a structure was not erected, firefighting equipment was provided in September 1942. A Class 125 Fire Truck was delivered by the J. Beam Company, San Jose, California. The crash truck bore no unit designation marker, but it was intended for the sole use of the Base. Don Thomson noted there "...wasn't a station. It was a truck, period. If there was an airplane crash, then, who ever happened to be available would hop on it and run out and see if they could find the pilot, or determine if the pilot was alive, dead, or what have you, and scoop up whatever was left."¹⁶⁷ Twenty-two enlisted personnel and three Non-Commissioned Officers were assigned to the Base to provide this firefighting service. These men were probably housed in the Desert Rat Hotel.¹⁶⁸

Second Building Campaign, 1942-43

An extensive building campaign was planned and executed after the XP-59A's first successful flight. This was the Base's second building campaign; it established the permanent military presence by building the Air Base Squadron structures. While the XP-59A continued its testing, new flight test projects arrived at the Muroc Flight Test Base. Lockheed and Northrop tested aircraft at the Muroc Flight Test Base during World War II.¹⁶⁹ The MX-324 Rocket Wing was an early Northrop project that arrived

¹⁶⁶. Kreger, 17.

¹⁶⁷. Thomson 1994b:23.

¹⁶⁸. Colonel Vanaman to Lt. M.J. Dodd, Muroc Bombing Range, Muroc, California; "Telegram"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

¹⁶⁹. LeVier, Tony. Interview by Dana Kilanowski on June 7, 1993, at Palmdale, California, pg. 22. Transcript of interview (OH-6A) on file at AFFTC/EM, Edwards AFB, California; Superata, 4-5.

in 1943 and first flew as a glider in September 1943.¹⁷⁰ It had its first powered flight in 1944. Lockheed's C-69 Constellation arrived at the Muroc Flight Test Base in 1943.¹⁷¹

New temporary buildings were authorized on 12 December 1942, two months after the XP-59A's first successful flights. This second building campaign included four (T-8, -9, -11, -12) 20' x 48' prefabricated commercial hutment (temporary building) barracks, a 700-Series 20' x 32' lavatory (T-14), a 700-Series 20' x 88' mess hall (T-10), a 20' x 98' prefabricated commercial hutment administration building (T-6), a 20' x 64' prefabricated commercial hutment supply building (T-7), and T-13, a 20' x 96' prefabricated commercial hutment recreation building.¹⁷²

This building order was changed in January 1943. On 9 January 1943, the original orders for four barracks was changed to seven prefabricated common hutments that could be dismantled and moved to a new location. The contract was let on 20 January 1943 and was completed in May 1943 by Ed R. Siple.¹⁷³ These barracks were scheduled to be built in multiples of 10-foot units, and were built in a slightly different configuration than the original order.¹⁷⁴ The construction plans for the mess hall

¹⁷⁰. Matthews, 13.

¹⁷¹. Pace, Steve. *Edwards Air Force Base: Experimental Flight Test Center*. Osceola, Wisconsin: Motorbooks International, 1994, 15.

¹⁷². Headquarters, Army Air Forces, Washington to Chief of Engineers; "Construction for Air Base Squadron at Materiel Center Flight Test Base, Muroc, California, December 12, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

¹⁷³. John W. Morris, Jr., 1st Lt., Air Corps, Base S-4 to Capt. Chapman, Materiel Command Flight Test Base, Muroc, California; "Memorandum, 17 April 1944;" List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

¹⁷⁴. Deming W. Morrison, Major, Corps of Engineers, District Regional Engineer, San Bernardino, California to Buildings and Grounds Division, Director of Base Services, Attention: Major Schuyler or Captain Vatet; "Directive Consecutive No. A 9066 Materiel Center Flight Test Site, Job No. 749, January 9, 1943";

were altered in early April 1943 to include an addition to accommodate the 207 enlisted men located at the Muroc Flight Test Base in spring 1943. The mess hall addition was scheduled to extend it by 52 feet in length. The mess hall addition was built, however, the three additional barracks were never constructed.¹⁷⁵

The mess hall's poured-in-place concrete foundation is extant. The mess hall had several additions attached to it in a linear fashion, including a ramp on the west facade. It extended approximately 140 feet in length. This mess hall was considered inadequate, and, when the second mess hall was built, it was transformed into the post exchange. The Muroc Flight Test Base post exchange was considered an annex to the Muroc Army Air Base post exchange. The original post exchange (P.X.) was located in building T-13, the dayroom. "The P.X. was only open for two or three hours a day and they sold only cokes and ice cream" according to Sgt. John Novak, who recorded a personal narrative about the Flight Test Base in 1945. Beer and medicine were added to the inventory, after the mess hall was converted to the P.X. The P.X. was open every day during the week and on Sundays. Beer was only available after 5:00 P.M. Laundry, dry cleaning, and a barber were also provided at the P.X.¹⁷⁶

The poured-in-place concrete lavatory building foundation rests on a small mound. Nothing remains from the other buildings, which suggests they were erected on piers, leaving nothing on the ground after buildings were dismantled. No discernable physical remains of the recreation building were identified, except a 1' x 4' concrete pad. The pad is located adjacent to the recreation building site and is probably a pad for a centered entrance on the north facade of the recreation building. An entrance was located on the south facade in the

Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁷⁵. J.G. Shively, Colonel, Air Corps, Buildings and Grounds Section to Chief of Engineers; "Additional Facilities, Materiel Center Flight Test Base, Muroc, California, April 8, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁷⁶. S. A. Jacobs. Muroc Flight Test Base Guide; Personal Account #1; Personal Account #3. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

same approximate location. The recreation building probably consisted of two 20' x 48' hutments attached end to end that formed a 20' x 96' structure. The recreation building housed a dayroom, the original post exchange before the first mess hall was converted into a post exchange, and the base library which had approximately 300 technical and non-fiction books. Billiards and ping pong were available at the dayroom as well.¹⁷⁷

A majority of the temporary buildings at the Muroc Flight Test Base such as barracks, the recreation building, the first administrative building, and the supply building were probably erected on piers. No physical remains from the administration building, barracks, the supply building, and the recreation building were identified. The administration building was destroyed in 1970; it was probably burned by the fire department for firefighting practice. The buildings that needed to have a level foundation such as the mess halls, the motor repair building, the inflammable storage building, the paint shop, and hangars have poured-in-place concrete foundations.

A 20' x 100' building was erected in the space between the recreation building and the infirmary. This building's poured-in-place concrete foundation has not been found on any World War II site plans or on post-World War II photographs. This suggests it was a post-1955 building for which we have no records.

Although the supply building, the administration building, the lavatory, and the recreation building had been authorized in December 1942, only half the buildings ordered had been built by April 1943. The four barracks and the mess hall joined the Unicon Hanger and the Desert Rat Hotel which were already standing in 1943.

Third Building Campaign, 1943

Eight additional buildings had been added to the construction program by 1 February 1943. This third building campaign included an Officers' Quarters OQM-J-M, two 80' x 120' standard Air Corps squadron hangars HANG-D-A, a 32' x 88' MRS-A-T Motor Repair Shop, a well, pump, and pump house, a 20' x 50' Civilian Conservation Corps (CCC) prefabricated hutment for use as a utilities storehouse and shop, and two 20' x 100' CCC

¹⁷⁷. S.A. Jacobs. Muroc Flight Test Base Guide. (written in September-October 1945). Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

prefabricated hutments.¹⁷⁸

This building plan changed extensively within 3 days.¹⁷⁹ The officers' quarters was changed to an 800-Series BOQ-40 that matched the Desert Rat Hotel. The two HANG-D-A hangars were changed to two bigger HANG-N-A hangars. The 20' x 50' CCC prefabricated hutment was changed to a 20' x 96' prefabricated commercial hutment utility shop and the two 20' x 100' CCC prefabricated hutments were changed to three 20' x 48' prefabricated commercial hutments. The construction directive was issued July 1943 and the contract was won by C. J. Paradis.¹⁸⁰

This campaign built the 477th Base Headquarters structures beginning in July 1943. 82 enlisted military personnel were assigned to the 477th, 75 permanently and 7 on detached service. The enlisted men included 22 guards, 7 firemen, 5 building maintenance men, and 3 people in the motor pool. Six administration personnel ran the base exchange and the visiting officers quarters. Four personnel did first aid, not including the three orderlies, and base and technical supply. Seven cooks and mess personnel manned the mess hall. Operations personnel included eight men working in the hangars, one working heavy equipment, and one photographer. Fifteen enlisted men worked as

¹⁷⁸. Ralph O. Brownfield, Colonel, Air Corps, Commanding, Wright Field, Dayton, Ohio to Commanding General, Materiel Command, Headquarters Army Air Forces, Washington D.C., Attn: Chief of Staff; "Additional Construction for Materiel Center Flight Test Base, Muroc, California, February 1, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁷⁹. L.P. Whiten, Brigadier General, U.S. Army, Director of Base Services to Chief of Engineers; "Additional Temporary Construction - Materiel Center Flight Test Base, Muroc, California, February 4, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁸⁰. John W. Morris, Jr., 1st Lt., Air Corps, Base S-4 to Capt. Chapman, Materiel Command Flight Test Base, Muroc, California; "Memorandum, 17 April 1944;" List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

aircraft mechanics.¹⁸¹

These properties were constructed along the lakeshore and the second section of the grid west of the hangars. The first section of the grid was not initially used. It became the swimming pool site in late 1943, and now houses three modern buildings built in 1968 and 1970 to support the U-2R flight test project. The hangars were built with the aircraft opening facing the lakeshore towards the east. The officers' quarters, hutments, and Motor Repair Shop were sited both parallel and perpendicular to the grid. The hangars and the well, pump, and pumphouse are the sole standing structures from this building campaign.

The second BOQ (T-15) was identical to the Desert Rat Hotel, except for the 30-foot shed on the west facade of the Desert Rat Hotel. The BOQ was located adjacent to Hangar No. 2; it probably housed personnel from the companies whose projects were housed in that hangar, as well as in Building 4505 after it was built in 1944. The BOQ was the first structure outside the grid. No remains of this officers' quarters were identified. The BOQ was a two-story, gable-roofed, balloon-frame structure that rested on concrete piers. Off-center double doors pierced the north facade that led to the second floor. A centered door was located on the west gable end. The windows had eight-over-eight sash, and the overhanging rafters were boxed. The gable roof was covered with rolled asphalt tar paper covering. A small vented attic probably housed heating and cooling equipment. The second story, which was initially reserved for the kitchen, storeroom and cook's room, was transformed into additional living spaces. The second BOQ did not have a messing facility; the officers ate at the mess hall that had recently been built. The BOQ housed 40 officers.

The HANG-D-A hangars were probably too small to meet the needs of the Muroc Flight Test Base. This requirement was changed within three days on 4 February 1943 to two standardized HANG-N-A hangars which were a third larger in overall size than the HANG-D-A hangars. The HANG-D-A hangars were 80' x 120', while the HANG-N-A hangars were 87' x 153'. The aircraft openings on the N-A hangars are 120 feet across, instead of the entire hangar being 120 feet wide, as in the D-A hangars.

¹⁸¹. H.G. Chapman, Captain, Air Corp, Commanding to Commanding General, Materiel Command, Wright Field, Dayton, Ohio; "Recommended Change of Status of the 477th Base Headquarters, June 16, 1943"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

Currently, the HANG-N-A hangars are used sporadically to house aircraft; the hangar areas are in good condition; however, the lean-tos are in poor shape.

The hangars (now known as Buildings 4401 and 4402) open to the east, toward the lakebed, which was used as the runway when these hangars were built. The hangars were a major part of the Base's focus and occupy a central place in the complex.

Buildings 4401 (T-21) and 4402 (T-22) are frame structures that rest on poured-in-place concrete foundations and are clad in vertical aluminum siding. Ten sliding doors open on the east facade; the hangar doors have pocket closures to house the doors when opened. Five vertical windows pierce each of the doors. Grooved concrete tracks guide the doors into and out of the pocket closures. On the east facade, two pilot doors allow personnel to enter from the apron without opening the aircraft hangar doors. The hangars have low-pitched parabolic roofs with straight-sided north and south facades covered with clerestory roofs. One-story shed lean-tos are attached to the north and south facades; the lean-tos extend past the pocket doors. The lean-tos housed offices during World War II. The shed lean-tos had an off-center door in the eastern third. Several room divisions are evident in the lean-tos; the windows are probably paired to divide the office spaces. In addition, several one-story lean-tos have been added to the east and west facades of the two hangars since World War II.

Ten modified wooden Pratt trusses support the roofs. The wooden trusses are similar to those found on early 20th-century railroad and highway bridges.¹⁸² The trusses are scarfed together to bridge the 120-foot distance. Triple banks of 12-light casement windows light the west half of the hangars; aluminum siding presently obscures the two bottom layers of windows. Twin banks of eight-over-eight sash windows originally lit the north and south facades, which have also been obscured by aluminum siding. A large five-to-one common American bond brick furnace stack is present at the southwest corners of Hangars No. 1 and 2 (Buildings 4401 and 4402). Boiler rooms were added to the hangars in 1944.

By August 1943, the hangars and the concrete aprons were under construction. General Electric probably had its engine

¹⁸². Jackson, Donald G. *Great American Bridges and Dams*. Washington, D.C.: The Preservation Press, 1988:24.

shop in Hangar No. 1 during World War II.¹⁸³ Hangar No. 1 was specifically mandated for the use of the Special Weapons Unit, which tested secret equipment including missiles. Hangar No. 2 was necessary to segregate aircraft and equipment that was not part of the Special Weapons Unit. Hangar No. 1 was later altered to house "an additional beam. This beam is to be erected 17 feet above the level of the floor and is to run the floor width of Hangar No. 1. The beam is to support a monorail and must be designed to support a maximum weight of 4,000 pounds. In view of the special experimental work being done on aircraft in this hangar, this deviation from the standard plans is considered justified."¹⁸⁴ The monorail was probably used as an engine hoist.

Jake Superata states "It [MX-324] was by that big hangar at the time, which would be about the center hangar."¹⁸⁵ The MX-324 Rocket Wing was housed in either Hangar No. 1 or Hangar No. 2 at the Muroc Flight Test Base. Hangar No. 2 was utilized by North American Aviation; Hangar No. 1 was used by Douglas and Curtiss-Wright in 1947. Hangar No. 1 housed the F-101 Voodoo in the mid-1950s, and Hangar No. 2 in the 1960s housed the TV2, the Navy's version of Lockheed's T-33 trainer.¹⁸⁶

A 32' x 88' MRS-A-T Motor Repair Shop (T-16) was also built as part of this building campaign. Located west of the original road and south of the grid as it existed in 1943, the Motor Repair Shop serviced automobiles and automobile engines, not jet engines. The Motor Repair Shop was a one-story, gable-roofed, frame structure resting on a poured-in-place concrete foundation. Ventilators pierce the gable roof. The motor repair building's walls appear to be made from gypsum wallboard. The roof has an 88-foot center gable that rises up 6 to 8 inches above the roof level. Five sets of double doors are on the shop's east facade, which faces the hangars. Paired four-over-six sash windows pierce the double doors. The shop had the space to repair five vehicles. The workspace was a large open area; office spaces

¹⁸³. Thomson, 1994b:3.

¹⁸⁴. J.C. Shively, Colonel, Air Corps, Buildings and Ground Section to Chief of Engineers; "Monorail Support Beams, Materiel Command Flight Test Base, Muroc, California, August 20, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁸⁵. Superata, 8.

¹⁸⁶. Edwards AFB Real Estate Records.

were probably located on the north facade. A door to the office spaces was located on the east facade. The north, south, and west facades each had a bank of 12-light windows that rotate on a center pivot. The motor repair building was dismantled in the late 1950s; a poured-in-place concrete foundation is all that remains.

A second well (Well No. 2), pump, and a pump house were requested during this building phase. The original well had an inadequate capacity and a bacteria problem which required chlorinization. This new facility was required as a standby for the original well. Building 4311 covers and protects Well No. 2, which is in service. Building 4311 is a small one-story frame utility structure raised on a poured-in-place concrete foundation. It is 10'4" x 8'4" and has a shed roof. This building provided water for both fire protection and domestic purposes.

Buildings 4316 (Deluge Water Storage) and 4317 (Water Pump Booster Station) were built in 1943. These utility structures are located north of the Unicon Portable Hangar. Building 4316 has the capacity to store 200,000 gallons of water, and Building 4317 contains the pumping station for the water. Building 4316 is a round, wooden structure built into the ground; it has a depth of 17'6" and is 88'6" in diameter. A raised octagonal lantern in the center of the building contains one of the access ways into the storage area. The Water Pump Building, Building 4317, is also partially built into the ground, and measures 43' x 20'. Stairs on the west facade provide access to the pumping equipment. The stairs are covered by a rotting shed roof. The windowless building has a gable roof with patchwork roofing. Neither building is currently in service.

The Imhoff sewer system was also built during this building campaign.¹⁸⁷ The system included the septic tank, the sewage lagoon, and the sewage pumping station. Building 4330, the sewage pumping station, is a one-story, 8' x 8', gable-roofed building. The sewage pumping station rests on a poured-in-place concrete foundation. It has a single door on the north facade. Building 4331, Imhoff Tank, is a wooden underground tank that houses sewage before it is discharged into the lagoon. The

¹⁸⁷. John W. Morris, Jr., 1st Lt., Air Corps, Base S-4 to Capt. Chapman, Materiel Command Flight Test Base, Muroc, California; "Memorandum, April 17, 1944"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

sewage is discharged through a pipe, down a ditch, into the lagoon, which was built on the edge of Rogers Dry Lake.

A 20' x 96' prefabricated commercial hutment utility shop and three 20' x 48' prefabricated commercial hutments were built in late 1943. No physical remains from these buildings were identified during the survey. Building 4307, a 1969 supply warehouse, was built over the approximate location of the World War II utility shop. The utility shop probably housed spare aircraft parts and equipment. The three barracks were probably raised on concrete piers similar to the officers' quarters, which explains why no physical remains from these buildings were identified. The barracks probably housed enlisted personnel, whose numbers reached 207 by spring 1943. In totality, seven barracks for enlisted personnel and two officers' quarters for contractors and officers had been built by the time the second set of barracks were completed.

Fourth Building Campaign, 1943

Flight operations had been conducted on the lakebed before the construction of the runway in 1942 and 1943. Muroc Dry Lake is a playa basin which receives seasonal water from local drainages. Water had an obvious detrimental impact on the lakebed's use as a runway. It was satisfactory to use the 22,000 lakebed runway during an extended dry season, but not after a rainy season. The year 1943 was extraordinarily wet; flight operations were suspended and moved off-Base until April 1943.¹⁸⁸ Moving the XP-59A off-Base created a security risk that could have been eliminated if a runway were present at the Muroc Flight Test Base. After the heavy rainfall of the winter 1942, building a runway and taxiway was considered a priority. The Army wanted to facilitate all-weather flying operations.

In June 1943, Brigadier General F.O. Carroll at Wright Field authorized the construction of a runway and taxiway at the Muroc Flight Test Base. This was the fourth building phase. The runway was planned to be 150 feet wide by 6,000 feet long with a taxi strip to connect the present hangars with the proposed runway. The taxiway was planned to be 75 feet wide by approximately 2,500 feet long. M. J. Ruddy and Son built the

¹⁸⁸. Thomson 1994b:22; Document explaining procedure followed in setting up the base. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

taxiway as designed.¹⁸⁹ The taxiway extends from the northern edge of the lakebed adjacent to the hangar apron to the runway. The concrete runway was designed to accommodate a minimum wheel load of 90 pounds per square inch.¹⁹⁰ A second taxiway was planned. It was to extend from the taxiway along the lakebed to the east end of the runway. The second taxiway that would have created a triangular runway plan was never built.

The airstrip was constructed during the winter of 1943. It was in place and ready by April 1944; however, it had been put into use several months earlier before the shoulders were finished. Runway marker lights, taxi guidance lights, a rotating beacon, a rigid wind indicator, and obstruction lights were added in mid-1944.¹⁹¹ The runway and taxiway have not been modified except for routine maintenance over the last 50 years.

Once the runway was under discussion, the Muroc Flight Test Base was considered an appropriate location for testing a large experimental aircraft. Convair's B-36, which had a loaded gross weight of 265,000 pounds, was originally a six-engine pusher-prop bomber that could strike Europe from North America. It was scheduled for flight testing at the Muroc Flight Test Base, however the huge cylindrical bodied B-36 was never tested at the

¹⁸⁹. List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

¹⁹⁰. F.O. Carroll, Brig. General, U.S.A., Chief, Engineering Division, Wright Field, Dayton, Ohio to Buildings & Grounds Section, Supply & Services Division, Asst. C/AS, M.M.&D.; "Construction for Materiel Command, Flight Test Base, Muroc, California, June 10, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

¹⁹¹. L.P. Whitten, Brig. General, U.S. Army, Chief, Air Services Division, Office of Asst. Chief of Air Staff, Materiel, Maintenance & Distribution to Deputy Chief of Air Staff, Attn: General Perrin; "Construction of Night Lighting Facilities for the Materiel Command Flight Test Base, Muroc, California, March 10, 1944"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

Base.¹⁹² The heavy aircraft required a pavement suitable for a gross load exceeding the maximum policy of 120,000 pounds. Convair was scheduled to deliver the B-36 in early 1944; however, the aircraft was actually delivered to the Army in late 1946.¹⁹³

Fifth Building Campaign, 1943-44

The year 1943 continued at a frantic pace at the Muroc Flight Test Base. Construction was ordered as personnel increased in accordance with additional flight test projects. Projects such as the flight testing of Northrop's XP-79B, an early jet flying wing project and Lockheed's XP-80 *Shooting Star* which began initially in November 1943, but was moved back to early 1944 after solving a compressor problem, arrived at Muroc Flight Test Base in late 1943 and early 1944.¹⁹⁴ It was thought that upward of 2,000 personnel might be working at Muroc Flight Test Base on the XP-80 flight test project, and other anticipated projects.¹⁹⁵

This construction program, which was built by Albert Reingardt, erected a majority of the Base.¹⁹⁶ Two small projects completed the Base during 1944 and 1945. The fifth

¹⁹². L.P. Whitten, Brig. Gen., U.S.A., Chief, Supply and Service Division to Deputy Chief of Air Staff; "Construction for Materiel Command Flight Test Base, Muroc, California, June 14, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.; Jones, Lloyd S. *U.S. Bombers: 1928 to 1980s*. Fallbrook, California: Aero Publishers, 1980:124-126.

¹⁹³. Jones, 124-126.

¹⁹⁴. Gunston, Bill, ed. *The Illustrated History of Fighters*. New York, New York: Exeter Books, 1981:147.

¹⁹⁵. Alden S. Crawford, Colonel, Air Corps, Chief of Staff to Headquarters of the Army Air Forces, Washington, D. C. Attention: Ass't Chief of Staff-Personnel; "Request for Change in status of 477th Base Hq. & Air Base Squadron (RS) to 477th Base Hq. and Air Base Squadron, 23 June 1943"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

¹⁹⁶. List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

building campaign was centered around providing for the increased needs of the enlisted personnel at the Muroc Flight Test Base and enhancing the flight test role of the Base. Colonel W.L. Doolan, Jr. noted that the "total troop strength at the Materiel Command Flight Test Base will be increased to a total of 400 or more enlisted men...the present strength now reaches a total of 94 enlisted men, which fact indicates that troop facilities must be provided for 300 or more men."¹⁹⁷ This building campaign was planned in August 1943 and was carried out during the fall/winter 1943 and 1944. This building campaign constructed the main living area that was subsequently demolished in the late 1950s.

This building campaign established the Muroc Flight Test Base's overall form. The U-shaped section above modern North Base Road was established and the first building was erected on the east side of the taxiway. The grid sections north of the Unicon Portable Hangar were first used during this building campaign. The grid section immediately north of Hangars No. 1 and 2 was first built upon during this time period; a swimming pool was constructed in this area.

The Muroc Flight Test Base is a spartan natural and cultural landscape. Its location in the western Mojave Desert underscores the Army's desire to create an efficient organization focused on the rigors of flight testing experimental aircraft. Since few diversions existed in this area, contractors and military personnel were forced to rely primarily on military largesse for recreational outlets, in their few spare moments, or they created their own diversions.

Recreation took on several additional forms at the Muroc Flight Test Base. The personnel travelled off-Base to Pancho Barnes's Happy Bottom Riding Club and to Ma Greene's restaurant in the town of Muroc, until the military bought them out in the early 1950s. Until the military condemned the Happy Bottom Riding Club, it benefitted from the austerity and paucity of recreational outlets at the Muroc Flight Test Base. Weekend passes were granted and trips were occasionally taken to

¹⁹⁷. W.L. Doolan, Jr., Colonel, Air Corps, Acting Adjutant General to Commanding General, Army Air Forces, Washington, D.C., Attention: Asst. C/AS-MMD, Construction Branch, Supply & Services Division; "Additional Construction Facilities for the Materiel Command Flight Test Base, Muroc, California, August 24, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

Hollywood, Mojave, Bakersfield, and Lancaster.¹⁹⁸ These off-Base trips often included heavy drinking and carousing. The Muroc AAB (later Muroc AFB) Officers Club was also a hangout for Muroc Flight Test Base personnel after World War II.¹⁹⁹

The military creatively utilized workspaces for recreational purposes. Technical Sergeant Milby Chestnut noted that "...a basketball court was set up in one hangar. However, there were usually too many planes in the way to play."²⁰⁰ A newspaper was published at the Muroc Flight Test Base, which provided entertainment, war news, safety information, community-related information, and published original and reprinted cartoons, including Milton Caniff's famous *Male Call*. Technical Sergeant Edwin C. Brown relates that he "...was the first Editor of the Murocket, which was originally started as a News Letter with Lt. Weist in charge. We wanted to start a paper but couldn't get any help with it. Col. Zaiser offered a case of beer as a prize for the best name suggested for the base paper. I won, only to find that the money to buy the beer was locked in the safe. We finally had to blow the safe open to get the money. The paper was published once a week."²⁰¹

Athletic facilities were also provided at the Muroc Flight Test Base. A pool was built at the Muroc Flight Test Base in late 1943 to help raise morale and lower temperatures. It was Muroc's second pool, the first had been built at Muroc AAB. Regarding the first pool, it was noted that "Considering the intense heat in the Mojave Desert during the summer months, a swimming pool is badly needed for the general welfare and

¹⁹⁸. Thomson, Donald G. Interview by John Terreo on June 20, 1993, at Edwards AFB, California, pp. 3-4, 14. Transcript of interview (OH-8) on file, AFFTC/EM, Edwards AFB, California; Brewer 1993:3, 15.

¹⁹⁹. Brewer 1993:3.

²⁰⁰. Personal Account #2. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²⁰¹. Personal Account #5. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

contentment of the personnel."²⁰² The pool was centrally located in the middle of the Base emphasizing its importance. A baseball diamond, archery range, and volley ball courts were also provided;²⁰³ however, no remains of these athletic facilities were identified at the Muroc Flight Test Base.

Athletic activities also included firearms. A skeet range and a small arms range were located on the Base's east and west flanks. The skeet range was established in mid-1945. It was inaugurated in August by a pilot's skeet shoot; however, no one shot well.²⁰⁴ The skeet range was located on the west flank of the Base adjacent to the lakeshore; it has been disturbed by a cable right-of-way. The shooting area is oriented toward the north. The skeet range is composed of six 2' x 4' skeet stations and the remains of a skeet pull. The stations are arranged in a semicircle, the stations are approximately 3 feet in height, and were capped with a small plywood platform. Fragments of "Black Diamond" and "Comet" brand black skeet pigeons and "Federal No. 12 Monark" shotgun shells litter the site.

The small arms range was located on the Base's east flank. The small arms range was oriented east/west. The shooting area was east toward the lakebed. The small arms range has heavy metal sheeting laying on the ground that was possibly used to create a temporary road or smooth area. Five 2' tall wooden posts, possibly ammunition stands, occur at the end of the range. A half buried bunker is also present; it probably housed the target launching system. A table and chair are present in the bunker, and broken skeet is present at the small arms range.

The swimming pool was one of several landscape elements at the Base not directly related to the flight test mission or to Base housing. Entertainment facilities were provided as well. The recreation building was one; the 700-Series 37' x 127'

²⁰². "Annual Base Construction Update, 1942"; Air Adjutant General, 1939-1942, Records of the Army Air Corps, Muroc Bombing and Gunnery Range, Record Group 18, National Archives, Washington D.C.

²⁰³. S.A. Jacobs. Muroc Flight Test Base Guide. (written in September-October 1945). Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²⁰⁴. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

one-story frame, REC-A-T type theater/chapel (T-73) was another. It was built in late 1944/early 1945 for the enlisted personnel. Before 1945, personnel were allowed to go to Muroc AAB every other night to see a movie.²⁰⁵ The Base's newspaper *Murocket*, stated "The recreation hall will be so constructed that it may be used as a chapel, a moving picture theatre, a dance hall, and a general entertainment hall. One end of the building will be occupied by a stage."²⁰⁶ Movies were shown three nights a week: Sunday, Tuesday and Friday. U.S.O. shows were normally held on Wednesdays.²⁰⁷

The theater was one of the first buildings built beyond the grid as the Base expanded. The theater/chapel no longer stands; the two sections of the raised poured-in-place concrete foundation are all that remains. It was heated by an external brick chimney on the west facade; the chimney is now scattered. Don Thomson notes that the theater was quite bare. He states "It was basically a supply building and it had nothing but wooden seats and rows of seats" and that "we would take seat cushions off the parachutes, and what have you, so we'd have something to sit on."²⁰⁸

The theater was racially segregated, as was the entire military during World War II. Chuck Sampley, a Muroc Flight Test Base fireman, stated that he stood fire guard when the "...colored went to the show."²⁰⁹ The housing at the Muroc Flight Test Base was segregated as well; the African-American soldiers had separate barracks from the Anglo-American soldiers. The African-American population was primarily enlisted service

²⁰⁵. Personal Account #3. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²⁰⁶. "Construction of Rec. Hall Well Underway: Completion Date Estimated Between March 15th and 30th," *Murocket* Vol. I No. 17, January 3, 1945, Muroc, California.

²⁰⁷. S.A. Jacobs. Muroc Flight Test Base Guide. (written in September-October 1945). Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²⁰⁸. Thomson, 1994b:15.

²⁰⁹. Sampley, Charles L. "Chuck". Interview by John Terreo on April 8, 1994 at Mojave, California, pg. 7. Transcript of interview (NBOH-2) on file, AFFTC/EM, Edwards AFB, California.

personnel at Muroc Flight Test Base.²¹⁰

Military Construction During the Fifth Building Campaign

The fifth building campaign included a 20' x 56' IN-B-T infirmary, a 20' x 32' L-D-T lavatory, a 20' x 56' L-E-T lavatory, a 20' x 40' GH-A-T guardhouse, a 20' x 48' prefabricated supply room to be added to the present 20' x 68' structure, an M-S-T cafeteria-style mess hall, seven 20' x 96' prefabricated barracks, and nine 20' x 48' demountable prefabricated barracks. A housing alternative was to build eleven 20' x 100' B-A-T barracks; however, this alternative was not chosen.

The barracks and allied community support buildings were arranged in a "U" form that mirrored the Base's U-shaped plan. The U-shaped street plan surrounding the community support area was designed in association with this building campaign. The roads and the grid plan were not planned in a deliberate manner; it was a vernacular, accretionary process that was part of the associated building campaign. The U-shaped road around the community support area was built at the same time as the buildings.

In addition to the community support buildings, several buildings were erected to support the mission. These buildings, necessary for the proper functioning of the flight test work, included a 32' x 96' WH-A-T warehouse, a 40' x 80' FS-A-T firehouse, and a 5,000-gallon gasoline underground storage tank with a pump for the more than 20 automobiles at the Muroc Flight Test Base.²¹¹ A 20' x 48' prefabricated instruction building was requested for engineer and aircrew member training who worked on the experimental aircraft projects at the test base, but it was never built.

This fifth building campaign was substantially altered in September 1943. The changes would have greatly increased the size of the Muroc Flight Test Base. Twenty-three 20' x 48'

²¹⁰. Sampley, 18.

²¹¹. W.L. Doolan, Jr., Colonel, Air Corps, Acting Adjutant General to Commanding General, Army Air Forces, Washington, D.C. Attention: Asst. C/AS-MMD, Construction Branch, Supply & Services Division; "Additional Construction Facilities for the Materiel Command Flight Test Base, Muroc, California, August 24, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

prefabricated commercial hutments for use as barracks were planned, instead of the initially planned 16 barracks. Fourteen of these barracks were to be erected as seven 20' x 96' barracks; the remaining nine were to be erected as 20' x 48' barracks. Additionally, the Army's schedule called for a 700-Series 20' x 40' L-D-T lavatory, a 700-Series 40' x 132' M-P-T mess hall, a 32' x 88' FS-A-T firehouse, a 12' x 16' GA-A-T gas station, and an additional 20' x 48' prefabricated commercial hutment for use as a school building.²¹²

The only buildings in this order constructed were the gas station and the school. The other buildings were modifications of the previous building authorization. The gas station and the school were added to the original building authorization, the 700-Series 20' x 40' lavatory was built instead of the 20' x 32' lavatory that was originally indicated, and the 32' x 88' FS-A-T firehouse was built instead of the 40' x 88' FS-A-T firehouse.

The main object behind this building campaign was to support the 300 enlisted personnel scheduled to arrive at the Muroc Flight Test Base. The one-story frame barracks were primarily built in the U-shaped area north of modern North Base Road. The U-shaped grid extends north to a building restriction line was in place for safety purposes. The building restriction line mirrors the runway and the taxiway.

Seven 20' x 96' prefabricated barracks, and eight 20' x 48' demountable prefabricated barracks were built during this period. The eight 20' x 48' hutments were shipped, already erected for immediate use via railroad to Muroc from the Air Service Command Ogden, Utah. The seven 20' x 96' prefabricated barracks were probably built onsite. The 20' x 48' barracks housed 18 soldiers, and the 20' x 96' barracks housed 36 soldiers. Charles Barth, a control tower operator, characterized the 18-man barracks as satisfactory, but noted the lack of air conditioning and that it was impossible to keep one's clothes clean due to the blowing dust.²¹³ The quarters were ample, since the barracks

²¹². J. C. Shively, Colonel, Air Corps, Buildings and Grounds Section to the Chief of Engineers; "Additional Construction Facilities for the Materiel Command Flight Test Base, Muroc, California, September 7, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

²¹³. Barth, Charles J. December 15, 1944. Historical Data. Army Air Forces. Army Airways Communications System. Detachment 101st Army Airways Communications System Squadron. Muroc Flight

were built to accommodate approximately 400 personnel, not the 300 new enlisted personnel and contractors expected at the Muroc Flight Test Base.

None of the barracks currently stand. Churned and broken concrete is possibly the remains of a 20' x 96' barracks. These buildings were dismantled in the late 1950s, when a majority of the Base was dismantled. No physical remains from the barracks were identified, except the one barrack. The barracks were probably erected on concrete or wooden piers, which left a limited archaeological component. The extant 4' x 6' foundations mark porch locations. The barracks erected east of the grid was probably torn down to provide a location for the extant 1954 firehouse.

The complete numbers of enlisted housing units were not built at the Muroc Flight Test Base. It is possible that the failure of defense projects, such as the MX-324, the XP-79B, and the XP-58 necessitated a change in building plans during World War II. Funding was tight for nondefense related projects during World War II; building projects needed to be tied directly to a defense project to ensure that a facility was built. As a result of this policy, stateside military housing projects were not actively funded during World War II.

Military housing was a major stateside mobilization problem during World War II and into the early 1950s. Military housing was an especially acute problem at Bases which were isolated with sparse, local civilian populations, where military families could not find housing. A letter from J. J. Robson of the Firestone Tire and Rubber Company to Senator W. F. Kowland, dated 7 October 1948, summed up this problem, "One thing that was noticeable at this Base [Muroc] was the deplorable condition of the housing for personnel. Many of the personnel are forced to live in trailers and shacks, and certainly it will not be possible to attract the right kind of technicians with this condition existing."²¹⁴ Furthermore, the military housing problem was exacerbated because stateside construction was temporary construction and the military was not sure which bases it would keep active after the

Test Base, Muroc, California. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²¹⁴. J.J. Robson, The Firestone Tire and Rubber Co, Los Angeles to Senator W.F. Kowland, Oct 7, 1948; General Correspondence, Headquarters United States Air Force, Office of the Assistant Chief of Staff, Installations, Muroc Air Force Base, Record Group 341, National Archives, Washington, D.C.

conflict was over. As a result, the military did not build enough military housing during World War II for returning soldiers.

Community support buildings were also erected during this building campaign. A 20' x 56' IN-B-T infirmary, a 20' x 40' L-D-T lavatory, a 20' x 56' L-E-T lavatory, and an M-S-T cafeteria-style mess hall were built to support the increased population. The infirmary was built in the second grid directly adjacent to the site of a post-1950s concrete foundation. The infirmary rested upon a poured-in-place concrete foundation, and was a one-story, gable-roofed, frame structure. The two lavatories were a 700-Series 20' x 40' L-D-T and a 700-Series 20' x 56' L-E-T lavatory. The L-E-T lavatory rests on a concrete foundation. The lavatories were one-story, gable-roofed, frame structures. The L-E-T Lavatory had six stalls, separated by a center passage. No physical remains from the L-D-T lavatory exist.

A 48' x 144' MD-A-T mess hall was built as a part of this building campaign. The mess hall was built in the U-shaped area north of modern North Base Road. The mess hall was oriented east/west, and paralleled the road separating the grid sections, rather than the U-shaped form, as did the other World War II structures. The requirements for the mess hall changed several times before the structure was erected. The mess hall plan was eventually changed to a 700 series mess hall, however, it was built utilizing the original dimensions.

The mess hall was a one-story, gable-roofed, frame structure which rested on a poured-in-place concrete foundation. It was a cafeteria-style mess hall that used steam tables to heat the meals. Mess hall space was divided into two areas: one each for enlisted personnel and officers. The mess hall was listed as providing space for upward of 500 people.²¹⁵ This provided a separate messing facility for officers. Messing facilities were segregated identically to quarters to minimize fraternization between men of different status. A driveway on the east facade allowed trucks to deliver supplies. The east facade probably had a set of double doors. Internal divisions display distinct cooking areas, a bathroom, eating areas, and storage areas. One G.I. (Government Issue- military slang for enlisted military personnel) noted that the: "Food was very good here...due to the small number of men to cook for, there were only 73 men, no line,

²¹⁵. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

food was hot when served; it didn't seem G.I."²¹⁶

The Muroc Flight Test Base was a self-contained, secured facility during World War II. The military attempted to provide for the contractors' and military personnel's every need. These people were asked to give up their lives, move to the desert, and test dangerous, volatile jet aircraft. This move began to include families. After the XP-59A's program began, the social groups at the Muroc Flight Test Base began reflecting American society as the Base grew. The community needed a school building for the children, since the Base was a secret facility that was not known to exist. This kept the children separate from the local schoolchildren and the military children at Muroc AAB who attended the public school in the town of Muroc and helped to maintain security around the Base. A 20' x 48' prefabricated barrack was erected in the second grid section north of the hangars. No physical remains of the school building were noted; the school was probably raised on piers similar to the other barracks. The space inside the school building was probably identical to the barracks. The building had a flexible, open plan that lent itself to a variety of different uses.

Structures were also erected during the fifth building campaign to support the Base's flight test mission. These support buildings were built primarily in the spaces adjacent to the hangars. The construction project included a 20' x 40' GH-A-T guardhouse, a 20' x 48' prefabricated supply room that was added to the existing 20' x 68' supply room, a 12' x 16' GA-A-T gas station and a 5,000-gallon gasoline underground storage tank, a 32' x 96' WH-A-T warehouse, and a 32' x 80' FS-A-T firehouse.²¹⁷

The 20' x 40' guardhouse was erected adjacent to the curve in North Base Road. It controlled access to the entire Muroc Flight Test Base until the officers' quarters were built along North Base Road in 1945. The guardhouse was the first facility built for security needs at the Muroc Flight Test Base.

²¹⁶. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Personal Account #3. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²¹⁷. J. C. Shively, Colonel, Air Corps, Buildings and Grounds Section to the Chief of Engineers; "Additional Construction Facilities for the Materiel Command Flight Test Base, Muroc, California, September 7, 1943"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

Although, a security fence surrounded the northwest portion of the lakebed, including the Muroc Flight Test Base, the immediate Base area was not directly secured. The guardhouse protected the direct approach to the Base from North Base Road, which accessed the county road system. The guardhouse was a one-story, gable-roofed, frame structure that rested on a poured-in-place concrete foundation. An internal division probably marks a bathroom.

The supply warehouse built during the second building campaign was expanded in 1943. A 20' x 48' prefabricated hutment was attached to its north facade during the fifth building campaign. This building unit was identical to the ones utilized for the barracks and the schoolhouse. The addition greatly expanded the Base's first storage space. No physical remains from this addition were identified.

Storage was a major issue for the Muroc Flight Test Base during this period. A warehouse was built during this building campaign. The 1943 WH-A-T warehouse, Building 4318, is 32' x 96'. The warehouse is situated north and parallel to the Unicon Portable Hangar. It is a one-story frame structure with a low, oblique, gable roof with ventilators. The warehouse is clad with bands of 2-foot horizontal siding and rests on a poured-in-place concrete foundation. The warehouse has four pairs of double doors on the east and west facades, and centered entrances on the north and south facades. The warehouse's double doors allow vehicles to load and unload equipment and material. Twelve-light casements windows open on a center pivot. This is the common window sash for all the buildings. The windows are arranged in banks of triple window units. An off-center door has been inserted on the east facade. The warehouse was converted to a gas station in the 1960s and is currently empty. The warehouse has not undergone extensive structural modification, although it was altered to house a gas station, including the installation of gas pumps east of the warehouse.

A gas station was built in association with the motor repair building during this building phase. It was a 12' x 16' 700-Series standardized GA-A-T gas station. It had a 5,000-gallon underground storage tank for storing gasoline, which easily served the Base's 20 vehicles. The gas station was a one-story frame structure. No physical remains from the gas station were identified; however, a 12,000-gallon diesel fuel tank, possibly associated with the gas station, was removed from an adjacent plot in 1994. The tank was active from 1958 until 1970, which possibly indicates that the gas station was destroyed in 1970.

A 700-Series FS-A-T firehouse was built during this campaign in early 1944. A firehouse had been noted as a distinct need since 1942. In 1943, the lack of a firehouse almost led to the loss of the fire equipment. The dust problem was so bad that the Equipment Inspector threatened to recall the equipment if it was not covered.²¹⁸ The firehouse was 32' x 88' and was 300 to 400 feet from the lakeshore; it was located adjacent to the historic access road that traversed the taxiway and accessed the complex on its east side. Ten to twelve men were assigned to the station. Chuck Sampley, a retired fireman, reports that, "The water would almost come up to the doors" when it rained.²¹⁹ The firemen lived at the firehouse for six days at a time, and they did the cooking, KP (kitchen patrol) duty, and the cleaning.²²⁰ The Muroc Flight Test Base supplied its own firetruck. The Base, due to its security constraints, provided fire services for the entire no-fly zone which extended east to Leuhman Ridge.²²¹

The firehouse was a one-story frame structure. It rested on a poured-in-place concrete foundation. An addition was made to the firehouse in 1944 that added a second stall, when it was completed it was a two-stall firehouse. The addition was built by C. B. Stratton²²²; it was 20' x 88' and attached to the firehouse's west facade. The addition effectively doubled the size of the firehouse. A second addition was attached to the northeast corner of the firehouse. The addition was 21'5" x 9'3". The foundation was poured in May 1949; the addition had one story. One of the workers signed the foundation. The original firehouse was torn down after the present 1954 firehouse was constructed.

²¹⁸. H.G. Chapman, Captain, Air Corp, Commanding to Commanding General, Materiel Command, Wright Field, Dayton, Ohio; "Recommended Change of Status of the 477th Base Headquarters, June 16, 1943"; Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²¹⁹. Sampley, 9.

²²⁰. Sampley, 10.

²²¹. Thomson, 1994b:23.

²²². List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

The present 1954 firehouse, Building 4456, doubled the size of the World War II firehouse. Building 4456 is located north of the historic access road that traversed the taxiway and accessed the complex on its east side. Its primary facade faces towards the lakebed, not modern North Base Road. The present firehouse was built as a permanent structure. This is reflected by the firehouse's architectural materials and its level of finish.²²³

The 1954 firehouse is a five-bay, one-story structure. It measures 112'9" x 83'4". It has five stalls on the south facade, storage spaces, offices, and a day room. The firehouse has living quarters, a kitchen, a recreation room, and a shower room for housing firemen for extended periods. The firehouse rests on a poured-in-place concrete foundation and has a flat roof. The frame walls are covered in stucco. A one-story, wrap-around shed has been attached to the north and west facades. A flat-roofed, two-story observation tower has been built in the southwest corner of the firehouse.

The firemen burned several of the World War II structures for fire practice, particularly in 1970 and 1971. They also dug a parachute drying pit that is no longer used.

Although the major buildings at the Muroc Flight Test Base were planned and executed in a deliberate manner, several of the utility buildings were not planned. These buildings seemingly popped up and were probably built with excess money. Several standing structures at the Muroc Flight Test Base were probably built in this manner. The buildings and the Edwards AFB real estate files are the sole data sources on these buildings. Buildings 4306, 4308, 4320, 4330, 4451, and 4452 house utility functions; these buildings were built in 1943 and 1944.²²⁴ These are small minimal, one-story, utilitarian structures. The buildings are unheated, provide no amenities, and were built with functional considerations as the primary factor. The buildings existed to provide shelter for the equipment and the workers maintaining the equipment. These buildings were probably built to meet the immediate needs of the contractors and the enlisted personnel at the Base. Buildings 4308 and 4320 are electrical substations. Building 4308 is in use providing electrical power to Building 4305; however, Building 4320 has been dismantled. Building 4330 is the sewage pumping station.

²²³. Edwards AFB Real Estate Records.

²²⁴. Edwards AFB Real Estate Records.

Sixth Building Campaign, 1944

The sixth building campaign began January 1944.²²⁵ It consisted of several diverse buildings that were planned at the same time, rather than one concerted building effort. During this campaign, the control tower, the HANG-P-A type hangar, the second administration building, and an operations building were built in early 1944, which began construction of the complex on the east side of the taxiway. A second taxiway and a base engineering building were planned, but not constructed.

The original control tower at the Muroc Flight Test Base was an old guard shack that had to be tied down to avoid takeoff during windstorms. It was located adjacent to Building 4305. Charles Barth wrote that:

The tower measured approximately 4 feet by 5 feet, on the floor, and stood about 6 feet tall on top of the 6 foot platform. There were three small windows in the sides, and a door. In order to observe the traffic it was necessary to step outside the tower, on the platform; and even then one end of the runway was obscured by the barracks in the building area. There was no heat or light in the tower. Additions were finally made to our equipment with the securing of a set of binoculars, a frequency meter, and a small fire extinguisher. There were portable runway lights on about one half of the runway, and these could be operated by plugging in the extension cord in the operations building. Weather information is obtained with the aid of a direct field phone line to Muroc AAB weather station from the operations office. Guy ropes to stakes in the ground kept the tower from falling off the platform. Occasionally it was necessary to anchor the tower with the aid of a jeep and tug when a severe sand storm arose.²²⁶

²²⁵. L.P. Hitten, Brigadier General, U.S. Army, Chief, Air Services Division, Office of Asst. Chief of Air Staff, MM&D to General Perrin, Chief of the Air Staff; "Additional Construction at the Materiel Command Flight Test Base, Muroc, California, 28 January 1944"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

²²⁶. Barth, Charles J. December 15, 1944. Historical Data. Army Air Forces. Army Airways Communications System. Detachment 101st Army Airways Communications System Squadron. Muroc Flight Test Base, Muroc, California. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

Communication with the outside world was via a field wire strung 11 miles to Muroc AAB and a light gun with aircraft. The grave situation was made worse since pilots often arrived faster than their flight plan notification, which posed navigation and security risks. A standard aircraft air to ground transmitter, a Hallicrafter SX-28 receiver, and field phones strung to the fire and crash stations and to the dispatcher helped alleviate this problem.²²⁷

The increasing numbers of flight test projects caused air control and communications problems in 1943 and 1944. In 1944, the XP-80, the XP-59A, the MX-324, the XP-58, and the Gloster Meteor were probably present. This is a large number of projects for a regular Base, or at a Base operating at less than full efficiency, since it was still under construction and was a temporary Base. The Base had approximately 40 landings and takeoffs per day in 1943 to 1944; the air traffic consisted mainly of accelerated tests and cargo aircraft delivering supplies.

As a result of the additional air traffic, the Muroc Flight Test Base secured a band of airwaves for its exclusive use and the Los Angeles District Engineer was authorized to erect one. The Army Air Corps furnished control and operation tower. The Army assumed that the necessary material was available on the site for this tower. However, the materials at the Muroc Flight Test Base were insufficient to completely erect a tower. It was then decided to obtain an extant standard 54-foot tower. The tower was shipped from Albuquerque Army Air Base, New Mexico in May 1944.²²⁸ The Weymouth Crowell Company erected the control tower.²²⁹

²²⁷. Barth, Charles J. December 15, 1944. Historical Data. Army Air Forces. Army Airways Communications System. Detachment 101st Army Airways Communications System Squadron. Muroc Flight Test Base, Muroc, California. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²²⁸. John M. Lyle, Lt. Col A.C., Buildings and Grounds Section Office, Ass't Chief Air Staff, MM&D to Commanding General, Materiel Command, Wright Field, Dayton, Ohio; "Control Tower to the Material Command Flight Test Base, Muroc, California, May 9, 1944"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

²²⁹. List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States

Operations began in the control tower in July 1944. Barth noted that:

We built our own receiver rack because we had none available of standard types. Operation was begun from the new tower even before there was any power available. An extension cord was dropped out of one of the windows down to the operations building, and another line was needed to obtain power in the tower from batteries to operate our ground to air transmitter. We still had to resort to the using of an aircraft installation until the squadron could send some men to permanently install the equipment that we had in storage pending the completion of the tower. At last we had enough room to install all four receivers that we had, and the post carpenters built and erected two operating positions for us.²³⁰

The aircraft transmitters were replaced by electric tower transmitters. A teletalk system linking the fire station, the base commanding officer, and the tower was added. New tower equipment also included a large telechron clock, with a sweep second hand, and a C-3 Signal Lamp.²³¹ In December 1944, the Army Airway Communication System detachment received two Hammerlund Super-Pro receivers and had a total of five receivers.²³² Within a year, the tower operations underwent an inspection and was found lacking. A remodelling program was initiated less than a year after the initial construction of the tower. New bench work, operating positions, re-wiring,

Air Force. Maxwell AFB, Alabama.

²³⁰. Barth, Charles J. December 15, 1944. Historical Data. Army Air Forces. Army Airways Communications System. Detachment 101st Army Airways Communications System Squadron. Muroc Flight Test Base, Muroc, California. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²³¹. Barth, Charles J. December 15, 1944. Historical Data. Army Air Forces. Army Airways Communications System. Detachment 101st Army Airways Communications System Squadron. Muroc Flight Test Base, Muroc, California. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²³². Plank, Tom M. Historical Record of Army Air Forces, Army Airways Communications Systems, Detachment 101st Army Airways Communications System Squadron, Muroc Flight Test Base, Muroc, California for December 1944. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

additional antennas and new receivers were erected, and minor modifications were made to equipment on hand. An interphone system was put in place, and the sides, roof, and floor of the control tower were insulated. Further, the detachment laid new linoleum and repainted the interior of the tower.²³³ Later in 1945, an auxiliary 10-LFA low frequency transmitter and a PE-78-F auxiliary power unit were installed to help reduce potential future concerns.²³⁴

The control tower, Building 4500, had a standard, steel I-beam framework with triangular cross braces. A staircase in the middle of the tower accesses the cabin. It is a freestanding structure located on the east side of the taxiway. The 14' x 14' tower has five sections and is painted alternately in red and white bands. The cabin has been boarded up; formerly the windows on each facade were utilized to spot planes. A catwalk surrounds the cabin on each facade. The control tower is no longer used.

The control tower was erected on the east side of the taxiway, directly in front of Building 4505. At the base of the control tower, an operations building was erected where the flight test work was directed. The 700-Series 20' x 100' OB-A-T operations building probably had similar architectural features to the 20' x 100' recreation building built during the second building phase. It was a one-story, gable-roofed, temporary frame structure. The operations building had an undifferentiated floor plan, except at the east facade, where bathrooms were probably installed at a later date. A heavy queen-post truss system-- an 18th-century roofing system was used to support the

²³³. Birckhead, Oliver W. Historical Data of Detachment 101st Army Airways Communications System Squadron, Muroc Flight Test Base, Muroc, California. February 1945; Baldwin, Warren R. Historical Data of Detachment 101st Army Airways Communications System Squadron, Muroc Flight Test Base, Muroc, California. May 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²³⁴. Baldwin, Warren R. Historical Data of Detachment 731st AAF Base Unit (101st Army Airways Communications System, AAF), Muroc Flight Test Base, Muroc, California. August 1945; Baldwin, Warren R. Historical Data of Detachment 731st AAF Base Unit (101st Army Airways Communications System, AAF), Muroc Flight Test Base, Muroc, California. September 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

roof.²³⁵ Two large 2'11" doors opened into the operations building on the south facade. The internal space was probably subdivided after construction was complete using false walls. A one-story frame 20' x 48' barracks building was attached to the operations building. The barracks were centered on the north facade of the operations building. The two buildings created a "T" plan. No physical remains from the operations building are extant.

The operations building was the epitome of temporary construction. The building forms were commonplace building units that created a new building in a new context, and were interchangeable depending on the function. World War II temporary construction was a folk architecture. It was composed of diverse building units that were an abstraction, and were malleable to different purposes. An abstract mental vocabulary unified the building units according to the dictates of military culture and common military construction practices.

J. F. Cummins constructed the last hangar, Building 4505 in 1944.²³⁶ It faces the taxiway toward the southwest. Building 4505, the HANG-P-A hangar, is the largest structure at Muroc Flight Test Base. It was originally scheduled to be a HANG-N-A type hangar with a 120-foot opening. However, Brigadier General Hitten on 28 January 1944 changed the building authorization to a HANG-P-A type hangar which has a 160-foot opening.²³⁷

The HANG-P-A hangar underscores the perceived importance of jet aircraft to the World War II war effort. Its size and existence were a testament to the Muroc Flight Test Base's continued successes during World War II's latter stages, and the

²³⁵. Upton, Dell. "Traditional Timber Framing." In *Material Culture of the Wooden Age*. Brooke Hindle, ed. Tarrytown, New York: Sleepy Hollow Press, 1981, pp. 35-96.

²³⁶. List of Contracts on File at MFTB. 15 January 1945. Muroc Flight Test Base, Unit History, 1 September 1942 - 30 June 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

²³⁷. L.P. Hitten, Brigadier General, U.S. Army, Chief, Air Services Division, Office of Asst. Chief of Air Staff, MM&D to General Perrin, Chief of the Air Staff; "Additional Construction at the Materiel Command Flight Test Base, Muroc, California, 28 January 1944"; Air Adjutant General, 1943-1945, Records of the Army Air Corps, Muroc Army Air Base, Record Group 18, National Archives, Washington D.C.

desire to provide space for additional classified flight test projects. The HANG-P-A hangar is oriented toward the southwest, facing the taxiway. It is oriented almost perpendicular to the first three hangars. The original road that accessed Building 4505 was south of the second BOQ; it directly accessed the HANG-P-A hangar.

The HANG-P-A is a huge, frame, multi-story hangar. It is 202' x 213'; it was planned to be 202' x 225'. The aircraft opening is 160 feet across, as Brigadier General Hitten specified. The hangar space is 160' x 210'10". The hangar is 19 bays wide; it rests on a poured-in-place concrete foundation. The walls were built on 4-foot centers, and were covered with gypsum wallboard. The hangar has been clad in vertical aluminum siding. Ten 25-foot-tall sliding doors open on the north and south facades. The hangar doors have pocket closures to house the doors on the east and west facades when the doors are opened. A 10-foot-wide centered overhead door granted clearance for large aircraft entering and exiting the hangar. Twelve blacked-over vertical windows pierce the sliding doors. Grooved concrete tracks guide the doors into and out of the pocket closures. Two pilot doors on the aircraft hangar doors allowed people to enter the hangar without opening the aircraft doors. The hangar has a low-pitched parabolic roof with straight-sided north and south facades covered with clerestory roofs. Louvered ventilators pierced the roof at the apex of the parabolic arch; the original ventilators have been replaced. One-story shed lean-tos are attached to the north and south facades; the lean-tos extend past the pocket doors. The lean-tos housed offices, rest rooms, coat rooms, and a boiler room during World War II. The Flight Test Branch was set up in Building 4505 center office, which was formerly used by Operations. The place was in somewhat of a dilapidated condition. Desks, tables, typewriters, and filing cabinets were acquired by scrounging or requisitioning, whichever means proved most expeditious²³⁸. A one-story concrete administrative, security, and mission planning wing was attached to the north facade of Building 4505 in the late 1960s.

Modified wooden Pratt trusses support the roof. The trusses are similar to those found on early 20th-century railroad and

²³⁸. V. H. B. Wilhite, Captain, Air Corps, Chief, Flight Test Branch. "Monthly Activation Report; covering 15 June to 29 July 1945. 31 July 1945." Army Air Forces. Muroc Flight Test Base. Muroc, California. Muroc Flight Test Base, Unit History, 1 July-31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

highway bridges.²³⁹ The trusses are scarfed together to bridge the 160-foot ceiling span. Nine-over-nine triple window units and 12-light casement quadruple window units illuminate the east and west hangar facades; aluminum siding obscures the windows that have not been removed to facilitate the building of the addition. A furnace has been added to the northwest corner of the hangar. The original boiler room and furnace was centered on the west facade; the boiler room and furnace were probably moved when the wing was added to the west facade.

The second administration building was the Base headquarters building. It was an OB-H-T type structure. It measured 100' x 120', and was organized in a "T" plan. The administration building was composed of two 20' x 100' units attached at right angles to form a "T." While still a temporary structure, the administration building was built with a greater sense of permanence. Instead of being elevated on concrete piers, it rested on a poured-in-place concrete foundation. The administration building was located on D Street in the second section of the grid west of the hangars. It faced west towards North Base Road, and commanded a view of oncoming traffic.

The only remains of the OB-H-T administration building is its poured-in-place concrete foundation. The administration building was a one-story, gable-roofed, frame structure. A heavy queen-post truss system was used to support the composition roof. The framing was covered with gypsum wallboard. The administration building had two doors on the west facade and a door on the south facade. A door was also on the east facade facing the complex. The primary facade was the west facade. The floor plan was an open plan with bathroom spaces in the western third of the wing. The remainder of the space was open and undifferentiated.

The inflammable storage building was the last building built during the 1944 building campaign. It was a 25'4" x 54' WHSE-1-A temporary building, located directly adjacent to the south facade of Building 4305, the Unicon Portable Hangar. The inflammable storage building was a one-story, gable-roofed, frame structure, resting on a flat poured-in-place concrete foundation. The floor plan divided the storage building into two rooms: one was 33 feet wide and one was 20 feet wide. An 8-inch wall divided the two sections, which was probably a double thickness wall. No interior door connected the two spaces, which were completely separate. Large 6-foot-wide service doors were on the south facade that accessed both spaces; a regular-sized door was on the

²³⁹. Jackson, 24.

north facade into the smaller room. The only extant physical remains from the inflammable storage building is, the poured-in-place concrete foundation.

Seventh Building Campaign, 1945

The last World War II building campaign saw construction of the remainder of the major buildings. The officers' quarters on North Base Road, the two large warehouses, and the paint and carpenter shop were built during this 1945 construction phase.²⁴⁰ This building phase underscored the Base's continued flight testing successes and its associated increased personnel and storage needs. In addition to the older projects still in residence, Northrop's XP-79B *Flying Ram* and Consolidated Vultee's XP-81 mixed jet and turboprop fighter were being tested at the Muroc Flight Test Base.

Two large "T"-shaped officers' quarters were built directly on North Base Road in 1945. The officers' quarters were approximately 1,000 feet west of the complex on the south side of North Base Road, segregated from the Base. The officers' quarters were 123' x 274' with 25-foot-wide wings that originally

²⁴⁰. As-Built drawings of Warehouses & Additional Housing for Officers, Location Plan, Grading & Paving, May 1945 (Sheet No. 2 of 16), Job No. Muroc ESA 210-48, Job No. Muroc ESA 210-49, Military Construction, Muroc Flight Test Base, Muroc, California; Warehouses & Additional Housing for Officers, Warehouse "A" Plans & Elevations, May 1945 (Sheet No. 4 of 16), Job No. Muroc ESA 210-48, Job No. Muroc ESA 210-49, Military Construction, Muroc Flight Test Base, Muroc, California; Warehouses & Additional Housing for Officers, Warehouse "B" Plan & Elevations, May 1945 (Sheet No. 5 of 16), Job No. Muroc ESA 210-48, Job No. Muroc ESA 210-49, Military Construction, Muroc Flight Test Base, Muroc, California; Officers Quarters Floor Plan, Foundation, Plan & Details, May 1945 (Sheet No. 12 of 16), Job No. Muroc ESA 210-48, Job No. Muroc ESA 210-49; Military Construction, Muroc Flight Test Base, Muroc, California; Warehouses & Additional Housing for Officers, Officers Quarters, Elevations & Details, May 1945 (Sheet No. 13 of 16), Job No. Muroc ESA 210-48, Job No. Muroc ESA 210-49, Military Construction, Muroc Flight Test Base, Muroc, California; Utility Yard & Shops, Carpenter & Paint Shop, Utility Shop & Lavatory, Plans & Elevations, May 1945 (Sheet No. 4 of 8) Job No. Muroc ESA 210-50, Job No. Muroc ESA 210-44, Military Construction, Muroc Flight Test Base, Muroc, California. Taylor and Barnes, Architects and Engineers, 803 West Third Street, Los Angeles, California. Records of the Army Corps of Engineers, Record Group 77, National Archives-Pacific Southwest Region, Laguna Niguel, California.

each housed 72 men.²⁴¹ The officers' quarters were one-story, frame structures that rested on raised poured-in-place concrete foundations. The officers' quarters were composed of 12' x 20' bedrooms, a communal shower room and toilet room, a storage room, and a heater room. The bedrooms had four closets. Centered windows pierced each bedroom, and an off-center door graced each bedroom on the opposite facade that exited into a long hall that accessed the entire building. Shelving lined the interior walls of the storage room. A parking lot and footpaths were outlined between the officers' quarters. After World War II, the western officers' quarters had a 130-foot long off-center, one-story addition attached to its western facade. The addition probably housed more bedrooms, and conceivably more service spaces as well. The sole physical remains are the raised poured-in-place concrete foundations.

Two large temporary warehouses were also built during this building campaign. The warehouses were located on the west side of E Street, which they faced, adjacent to the theater/chapel. High, raised poured-in-place concrete foundations are all that remain from the two warehouses. The warehouses were one-story, gable-roofed, frame structures, identical in plan and arranged in a mirror form. The floor space of each warehouse was 64' x 160' and divided into four bays. The warehouses were raised off the ground to facilitate vehicular access. A 24' x 9' ramp was attached to the east facade of the warehouses. The ramps extended the full length of the warehouses. A graded, oiled, and rocked parking area lies between the two warehouses. The warehouses provided storage space for large items and large amounts of equipment; equipment that needed to be moved using vehicles.

The utility shop was the last major building erected during World War II. As a self-contained facility, the Muroc Flight Test Base provided as many everyday services as possible in order to reduce traffic in and out of the Base. The utility shops helped maintain the facilities and even the aircraft if necessary. The utility shop was built in an ell form at the intersection of E Street and Second Street. The grid was expanded to provide space proximate to the hangars, where the services were needed.

The utility shop building was a one-story, gable-roofed, frame structure arranged in an ell form measuring 203'6" x 96'.

²⁴¹. Muroc Flight Test Base, Unit History, 1 July- 31 December 1945. Alfred F. Simpson Historical Research Agency. United States Air Force. Maxwell AFB, Alabama.

The west facade fronted Second Street and was the primary facade. The shops were arranged in a linear fashion. The utility shop building's plan was composed of commonplace spaces and units that combined to form a unique structure not normally built as a temporary building. The various shops were in the same building; however, they are not accessible between each other. Each shop was a discrete and individual workspace.

The utility shop building rested on a poured-in-place concrete foundation, which is its sole remaining building feature. Carpenter, paint, sheet metal, electrical, plumbing, and blacksmith shops were included in the building. The shop spaces had open plans with no fixed equipment. The different shops had individual doors that accessed the space toward the hangars, which was probably a utility yard. Ventilators were located at the apex of the gable. The windows were both fixed and movable; the sash alternated between 9-light and 12-light windows. Two triple window units lit on the paint shop. Gypsum wallboard covered the balloon framing system.

The paint and carpenter shops were on the wing fronting E Street. Two storage spaces were located at the east facade of the ell for the paint shop and general usage. A heater room was located between the paint shop and the carpenter shop. The carpenter shop, in the northwest corner, was the largest workspace; it was solely accessible via the vehicle ramp in the southeast corner facing the work yard. The carpenter shop probably did not have a drop roof. Two large 8" x 8" squared wooden posts supported the carpenter shop roof. Two triple window units on the west facade lit the carpenter shop; the north end of the carpenter shop is blank. The sheet metal, blacksmith, electric, and plumbing shops and the shower and bath spaces were on the north facade facing Second Street. The discrete workspaces had access to the workspaces from the work yard to the south. Paired storage spaces for the four workspaces split the shop areas. The storage spaces were ancillary to the workspaces and only accessible via the workspaces to which they are attached. Each of these workspaces is organized in the same manner as the carpenter and paint shops. The access is solely through the south facade; double doors mark each of these spaces. The north facade only has window piercings. The lavatory spaces at the east end of the utility shop were segregated from the workspaces. A shower room, wash room, and a toilet room comprise the lavatory spaces, which could serve approximately four people at any given time. A second heater room is directly adjacent to the lavatory spaces. This building period marked the end of World War II temporary construction at Muroc Flight Test Base.

Post-World War II Building Campaigns

The immediate post-World War II period was incredibly productive at Muroc Flight Test Base. In the late 1940s, flight test programs proliferated and the Base grew to meet flight test needs for several years. Among the major flight test projects were the XB-43 *Versatile II*, B-45 *Tornado*, P/F-86 *Sabre*, D-558-I *Skystreak*, XFJ-1 *Fury*, XB-46, XP-87 *Blackhawk*, and the F-89 *Scorpion*.²⁴² These programs dictated that the Base maintain its facilities and even expand its capabilities. The community support area was expanded primarily to house contractor personnel from more aircraft companies and an expanded military presence.

The Base expanded beyond the U-shaped grid on both its east and west flanks. Plans were already in order to expand the grid toward the west during late World War II. These plans were executed soon after the war's conclusion; the street plan and several buildings were in place by late 1946. The street was designed, but it later became a drainage and dust control ditch. The dust control ditch is arranged in an "L" form. It parallels Fourth Street and joins the dust control ditch that serves A Street on the east side of the U-shaped grid. Until the U-2 period, the post-World War II construction continued to be one-story, gable-roofed, frame structures.

The drainage and dust control ditches have three sets of paired poured-in-place concrete foundations on either side of the western ditch. These poured-in-place concrete foundations do not display indications of having supported buildings; they were possibly staging areas or were poured for small barracks that were never built. A small footbridge traverses the drainage and dust control ditches linking the pair of foundations. The footbridges contain culverts; one of the footbridges has a decorative rock facing. A fourth set of paired foundations is north of the dust control ditch.

Four poured-in-place concrete foundations parallel the paired foundations. These foundations lie west of the dust control ditch. Two dismantled radio tower foundations lay south of the foundations, directly adjacent to North Base Road. Northwest of the four foundations was a large parking lot and enclosure. It was scraped and barricaded with two large, whipsawed and squared, wooden barricades on the north and south facades. The parking enclosure has 12-foot bays. Four poured-in-place concrete foundations survive directly west of the

²⁴². Brewer 1994: 2-3, 6-10, 12-13, 16-18.

U-shaped grid within the area defined by the L-shaped dust control ditch. Three foundations are grouped in the southeast corner of the area; two of the buildings were standing in late 1946. The fourth poured-in-place concrete foundation is quite large and was placed in a north/south line parallel to the established road. Its distinct function could not be discerned.

Thirteen buildings were built on the east side of the grid, probably in the early 1950s. These buildings were primarily barracks with associated community support buildings, such as lavatories. Each of these buildings are represented by a poured-in-place concrete foundation. The first section of barracks paralleled North Base Road, perpendicular to the U-shaped grid. The outer array of barracks paralleled the U-shaped grid. A dust control ditch parallels the road, and is traversed by concrete footbridges that access the adjacent buildings. These bridges are not large enough for cars, which indicates parking was elsewhere. Moreover, the dust control ditches themselves could not be traversed with vehicles. Four 20' x 100' buildings that filled in the U-shaped grid area were built in the early 1950s. These four buildings rested on poured-in-place concrete foundations and paralleled the mess hall. These buildings were not built over any of the World War II buildings.

Two early 1950s support buildings were built adjacent to Building 4505, Buildings 4503 and 4504. Building 4503 is a flat-roofed, one-story concrete block pump house with a stucco covering that was built in 1952. The Water Pump Booster Station's, Building 4504, original pumping machinery is still extant and in use. Three sets of paired valves serve the water tank. Both GE and Fairbanks Morse and Co. 1765 rpm (revolutions per minute) induction motors pump the water. In 1975, the original boiler was replaced with a National BD boiler that operates at 125 psi (pounds per square inch) and 350°F. The pump house was built to pump water from a 500,000-gallon water tank into Building 4505 in case of fire. The Deluge Water Storage, Building 4503, was also built in 1952.

Growth stagnated at the Base in the mid-1950s after Main Base was built and the U.S. Air Force Test Pilot School was established at Edwards AFB in 1951. Flight test programs were directed to Main Base, and South Base, as World War II Muroc AAB became known. North Base, as the Muroc Flight Test Base became known, slowly became Edwards AFB's backwater. It was quickly relegated to testing such novel and marginal projects as the XFV-1 Pogo. In 1960, the U-2s operating in foreign operating locations were removed to North Base until tension over the Powers incident was relieved. The U-2s stayed at North Base for

the next several years.

Two structure were built to support this project-Buildings 4511 and 4498. Building 4511, Jet Fuel Tank Farm, is located at the southeast corner of the complex. It was erected in 1962, and originally was composed of three 25,000 gallon steel tanks. A chain link fence topped with three-strand barb wire enclosed the tank farm. Two double gates provided access to the tank farm. The tank farm was extensively rebuilt in the early 1990s. Six modern steel tanks have been erected at the location. Three tanks have a 20,000 gallon capacity and three tanks have a 12,000 gallon capacity. The tanks are laid in a concrete pan. Pumping and control equipment is located on the south side of the tank farm toward the lakebed. The tanks contain JP-5 jet fuel.

Building 4498, a supply warehouse, was built originally in 1964 as an addition to Building 4505. It housed an electronics testing laboratory that was a portion of the Building 4505 wing. The laboratory was removed from Building 4505 in 1968, and was transformed into a free-standing building. It is now a one-story, gable-roofed, standing seam metal building. It rests on a poured-in-place concrete foundation, and is 30'3/4" x 42'5". Service doors pierce the west facade. Building 4498 currently stands adjacent to Building 4505's south facade.²⁴³

The U-2s went to Davis-Monthan AFB, Arizona in the mid 1960s.²⁴⁴ This left the facility vacant for the U-2R flight test program, which began in 1967. An extensive and rapid building campaign was conducted to support the U-2R flight test project, which was based on the east side of the taxiway; although related construction occurred on both sides of the taxiway. This was North Base's last major building episode. A security fence was erected around the hangar complex on the east side of the taxiway. Building 4505 was the center of the U-2 project; it housed the aircraft. North Base Road was moved to its current alignment to facilitate erecting a guardhouse on the east side of the taxiway.

The original guardhouse, Building 4495, was built in 1967. It was a 8' x 14' shed roofed structure that rested on a concrete foundation and had transite asbestos siding. It was removed in 1992 to facilitate the placement of a modern replacement building. A new guardhouse, Building 4497, was erected in 1993. It was fabricated by Henges Manufacturing of Maryland Heights,

²⁴³. Edwards AFB Real Estate Records.

²⁴⁴. Riedenauer, 2.

Missouri. It is an in-place replacement for the 1967 guardhouse. The modern guardhouse has a small bathroom on its south facade, and sliding doors on the north and south facade. Windows on each facade allow the guard to view all directions.

The facilities necessary to administer the project and support the personnel were erected within the security fence. Building 4506, a one-story, concrete block, fully enclosed administration building, stands at the rear of the complex. It has an open courtyard in the center of the building. Building 4506 has been dubbed "The Little Pentagon."

Building 4506 is a conglomeration of a World War II Administration building and a myriad of at least four different additions that together create the modern building. The additions were built throughout the 1960s, as Building 4506 changed functions. Building 4506 previously housed the security operations for the complex. The heavily modified frame structure is now stucco-covered; it rests on a poured-in-place concrete foundation.²⁴⁵

A one-story concrete block administrative, security, laboratory, lunchroom, warehouse and mission planning wing was attached to the north facade of Building 4505. It was built in the 1960s, over a period of four years. The wing was built in four stages, by attaching Building 4463 to Building 4505 and building several additions that housed discrete functions. An electronic testing laboratory was built in 1964, and a laboratory, warehouse, and lunchroom addition was added in 1966. The major addition was built in 1968 in direct association with the U-2R flight test project.

The wing contained other unique spaces dedicated to physical conditioning for the pilots, because flying a high-altitude aircraft is rough on the pilot's body. The pilots underwent an important, life-sustaining regime before flying the U-2. Lieutenant Colonel Robert L. Riedenauer, USAF (Ret.) relates that the pilots needed:

The good high-protein breakfast, preceded by a good 8 hours of sleep and all that stuff. We did carry with us some sort of, like, applesauce or little tubes that you rolled up, and [you] had a little hole in your face mask for something like that so you could ingest a liquid or baby food while you were flying. I did a lot of water. We had a little water with us. Dehydration was probably the worst thing you

²⁴⁵. Edwards AFB Real Estate Records.

faced. If you just drink enough water during the flight, then it really wasn't a problem. Prebreathing, probably before you went on a high-altitude mission is just normal. The longer you are about to go fly, the longer you prebreathe.²⁴⁶

Building 4496 was originally built in 1964 as a supply shop. It is a concrete block structure with that rests on a poured-in-place concrete foundation. A gable roof covers the building. The primary entrance is on the north facade. Offices occupy the western two-thirds of the building, while the eastern third has service spaces radiating from a corridor.²⁴⁷ Building 4496 is currently the security facility for the Building 4505 complex.

Building 4515 was built in 1967 as a small, one-story shed. It was a 12' x 13', concrete block, police operations building. Building 4515 has been altered to become a small, fuel testing laboratory; it stands adjacent to Building 4511.

Building 4494 was originally built as an aircraft research testing area in 1967. It was converted for use as a cafeteria the next year to replace the lunchroom in Building 4505. Building 4494 is a square, one-story, concrete block structure with a projecting entrance on the south facade. A bank of single pane sash windows light the east facade. Building 4494 has a catslide gable roof that descends toward the east. The project Senior Pace personnel later used the cafeteria for parties, which included their wives.²⁴⁸

A gymnasium, Building 4493, and a tennis court were built for recreation purposes in 1967. The gymnasium is a 1½-story concrete block structure; wings are attached to the north and west facades. It rests on a poured-in-place concrete foundation and is covered with a pair of gable roofs. Large double doors enter the gymnasium on the west facade. Since no one lived at North Base, personnel only went to the Base for mission planning, or preparing for a research evaluation, or getting ready to fly; no barracks were built for the U-2R or the Senior Pace personnel.

The last building erected in the late 1960s on the eastern side of the runway was Building 4507, a liquid oxygen (LOX) storage facility. The 12' x 48' concrete block shed stands

²⁴⁶. Riedenauer, 10.

²⁴⁷. Edwards AFB Real Estate Records.

²⁴⁸. Riedenauer, 4.

adjacent to Building 4506. Building 4507 was built originally as a supply and equipment warehouse. Two roll-up doors are on the west facade facing toward Building 4505.

Buildings 4301, 4302, 4303, 4307, 4400, 4410, 4412, and 4444 were built on the west side of the taxiway between 1967 and 1970. These buildings supported the U-2R flight test program. Building 4301 is a small equipment storage building located due east across the parking apron from Building 4305. The concrete block shed is 12' x 10'. A 110' x 60' run-up pad is adjacent to Building 4301 to the north.²⁴⁹

Building 4400, a 1969 supply and equipment warehouse, was erected between Buildings 4401 and 4402. It disrupts the historic spatial patterning of the World War II hangars. Building 4400 is a two-story warehouse with flanking one-story sheds on the north and south facades, clad in vertical aluminum siding.

Building 4303, a 1967 one-story, flat-roofed, concrete block, air compressor pump building stands southeast of Building 4305. Building 4302, which was built in 1967 is southeast of Building 4303 across a chain link fence. Building 4302, a storm drain and sump pump, is completely underground. A used Edwards AFB signboard marks the location, which is covered with a poured-in-place concrete slab. The storm drain is 11'4" x 11'4", and 11'4" in depth. Building 4307 is a 50'½" x 100' standing seam metal building located directly behind Building 4305. It was built in 1969 and originally served as a supply and equipment warehouse. Large service doors pierce the east facade; the warehouse rests on a poured-in-place concrete foundation.

Buildings 4410 and 4412 were located at a distance from the majority of the U-2R complex centered on Building 4505, when they were built in 1970. These buildings were removed from the complex for safety purposes, since Building 4410 housed explosives. Building 4410 was a LOX storage facility; Building 4412 was the equipment shed for the LOX facility. Building 4410 is a 41' x 20', one-story, three-sided concrete block shed open on the east facade. A 29' x 40' concrete foundation has been built on the north side of Building 4410. The building and adjacent foundation are enclosed in a padlocked chain link fence. The LOX storage facility now stores miscellaneous equipment. Building 4412, the equipment shop, faces Building 4410. Building 4412 is a blank, one-story, 35' x 25' concrete block shed. A large sliding door pierces the west facade; a 10' x 12' concrete

²⁴⁹. Edwards AFB Real Estate Records.

slab fronts the door. The building has two rooms, an emergency eyewash station is in the southeast corner of the outer room. Building 4412 currently houses the Base Historic Preservation Office.

Building 4444 was built in 1968 as a communications building. It housed the transmitter and receiver for the U-2R flight test program. Building 4444 is a one-story, 29'4" x 42', concrete block shed. A covered entrance pierces the east facade facing Building 4505 across the taxiway. A fenced area on the east facade contains nitrogen gas tanks. An office space and a small bathroom are located in the south half of the building. The remainder of the interior space is undivided. Building 4444 has most recently housed the Base environmental chemistry laboratory, operated by Computer Sciences Corporation (CSC).

Associated with the Communications Building are a series of five radio towers. The towers were built in 1969-1970 and no longer stand. Remains of two radio towers are present at North Base. 4' x 6' concrete foundations house anchor bolts and 2' x 2' concrete blocks accommodate anchor bolt locations for the radio towers. The size of the anchor bolts suggests the importance of the anchor bolt to securing the tower. One of the radio towers was located on the grid between "A" and "B" Streets and Second and Third Streets. Each of the anchor bolt locations endures, however, nothing remains of the tower. The second tower was located outside the grid west of Third Street. The anchor bolt locations and foundations are extant. No material remains survive from the three smaller antennae locations. These towers allowed North Base to maintain contact with the U-2Rs in the flight test program and those of Project Senior Pace.

Construction activity at North Base has not completely ceased since 1970, but it has not been active. One structure was built during the 1980s. Building 4499 is a 58' x 16' concrete loading dock built in 1984 within the Building 4505 complex. It is situated on the east flank of the control tower and is oriented toward the north. Maintenance and parking have been the most important construction and landscape related activity in the last 25 years.

PROJECT INFORMATION

This HAER report had its genesis in a Phase II cultural resource evaluation of the North Base Complex (Muroc Flight Test Base, site California-Kern[CA-KER]-3350H at Edwards AFB conducted by Scott M. Hudlow, Architectural Historian, Environmental Services Department, Applied Technology Division, CSC, Edwards AFB, California. The cultural resource evaluation was completed for the Environmental Management Directorate of the Air Force Flight Test Center (AFFTC/EM). This study recognized that these structures may have significance because they are at or approaching 50-year limits and they relate to the World War II and Cold War eras. Oral history interviews were conducted, primary and secondary sources were consulted, and a complete architectural recording of each structure was performed photographically. A 267-hectare (660-acre) archaeological survey was also conducted.

The Phase II study determined that the hangars and some ancillary structures were eligible for listing in the National Register of Historic Places. It also demonstrated that anticipated ongoing maintenance, repair, hazardous waste cleanup efforts, and potential remediation and reuse at North Base resulted in adverse effects which merited mitigatory HAER documentation.²⁵⁰ The North Base area is directly adjacent to the Rogers Dry Lake National Historic Landmark (NHL). The Rogers Dry Lake NHL encompasses the northern third of the lakebed. It was designated a NHL by the Secretary of the Interior on 9 October 1985 under the Man-In-Space theme. Production of records for the Historic American Engineering Record, National Park Service, Department of the Interior is designed to meet the Base's requirements under Sections 106 and 110 of the National Historic Preservation Act (NHPA) of 1966, as amended, 36 Code of Federal Regulations (CFR) Part 800, *Protection of Historic Properties*; and Air Force Regulation (AFR) 126-7, *Historic Preservation*.

The historical background and sources from Mr. Hudlow's work were adapted by Richard K. Anderson, Jr. to meet the HAER report format and HABS/HAER standards as required by the Phase III

²⁵⁰. Routine maintenance, repair, cable upgrades, roof repairs, boiler replacements, Base Information Digital Distribution System projects, internal modifications, road repairs, underground storage tank removals, hazardous waste remediation, ductwork, and utility (waterlines, sewer lines, communications lines, gas lines, transmission lines, etc.) projects have the potential to adversely affect North Base.

cultural resource documentation project conducted by Mr. Hudlow. In addition to the HAER report adaptation, Mr. Anderson prepared three HAER measured drawings and collaborated with Mr. Hudlow in selecting sites for HAER photographic documentation as well as photocopies of historical photographs and drawings for inclusion in the HAER project record. Hudlow and Anderson conducted a 25-day field project surveying North Base sites with a Wild TC-1010 theodolite for the production of the HAER measured drawings; this work was later augmented with the assistance of William T. Miller to include the Small Arms range and a portion of "the Loop." Contemporary (1995) large format photography was conducted by Brian Grogan and Philipp S. Rittermann, Photography & Preservation Associates, Inc., Yosemite, California. Large format copy negatives of historic photographs were made by WP Photography at Edwards AFB. The HAER report, measured drawings and large format photography were prepared under CSC purchase order no. CS5-00020, 7 July 1995, Richard K. Anderson, Jr., Documentation Consultant, Columbia, South Carolina, vendor.

Primary and Secondary Research

Primary and secondary research for the Muroc Flight Test Base cultural resource evaluation was conducted between February and April 1994 and in June and July 1995. Primary records were reviewed at the National Archives in Laguna Niguel, California, and the National Archives in Washington D.C. The National Archives facility in Laguna Niguel provided historic construction drawings and site plans. The National Archives in Washington D.C. has an abundance of original materials that pertain to the history of the Base. The Construction Completion Reports were not located for the Muroc Flight Test Base, because the Army Corps of Engineers purged a majority of its World War II Construction Completion Reports in the early 1970s.

The Library of Congress was consulted at the time of the National Archives visit. The Maps and Geography and Prints and Photographs Divisions were consulted; no materials that directly related to the Muroc Flight Test Base were located. The Manuscript Division of the Library of Congress was consulted in July 1995. The Henry H. Arnold Collection was studied. Secondary information concerning the contractors who built the Muroc Flight Test Base was located at the Library of Congress as well as at the American Institute of Architects (AIA) Library in Washington D.C. The Alfred H. Simpson Historical Research Center at Maxwell AFB, Alabama was consulted in June 1995. World War II and post-War U.S. Army historical reports and historic photographs were reviewed.

On-Base historic resources were important. The Air Force

Flight Test Center History Office provided important photographic documentation of Muroc Flight Test Base's history. The Center History Office also contains useful written documents regarding North Base, including reports, articles, and circulars. Primary records in the custody of real estate and civil engineering at Edwards AFB were consulted, as well as any primary records deposited in the Center History Office. The real estate files record information concerning the construction of each of the standing buildings, and civil engineering houses as-built drawings of each of the standing structures. The Edwards AFB Technical Library and the base Library proved useful for locating secondary sources on flight testing and other topics applicable to the study.

Off-Base libraries and repositories were contacted and/or visited to complete the research effort. Beale Memorial Library (the main branch of the Kern County Library) in Bakersfield, California, was contacted, however, little relevant information was obtained. The eastern branch of the Kern County Library in Mojave, California, was also consulted. The Matarango Museum, Ridgecrest, California; the Boron Museum, Boron, California; and the Pioneer Village Museum, Bakersfield, California, were consulted. No relevant information was obtained at any of these repositories. The *Los Angeles Times* was contacted for relevant information on the Muroc Flight Test Base, but none was collected. The Los Angeles Public Library, Los Angeles, California contains periodicals that proved vital in gaining information on the contractors that built the Muroc Flight Test Base in the early 1940s.

Attempts were made to make telephone contact with a variety of aerospace contractors that had a presence at Muroc Flight Test Base. Northrop, Lockheed, McDonnell-Douglas, Rockwell International, General Electric (GE), and Bell Aerospace Textron were consulted for information on their respective projects tested at North Base. Relevant information was obtained from GE (XP-59A engine, the I-A), Northrop (F-89 and MX-324), and Rockwell International (previously North American Aviation, B-45, P/F-86, and F-100). Historic information was hard to obtain from several companies due to byzantine ownership changes and dissolution in some cases. This rendered it impractical to delve into how these companies used the hangars and other structures at North Base, and how their testing and maintenance operations were organized within the structures themselves. The interior photographs discovered in the National Archives and reproduced for the HAER photographic record shed some light on work activities in the structures.

An archaeological literature search revealed that 13

previous cultural resource surveys had been conducted within 1.6 kilometers (1 mile) of the study area. Of these, 13 surveys, two cultural resource evaluations in the North Base area have a direct bearing on the current study. First, a historic building evaluation of Building 4305 at North Base was conducted in 1992, and second, the North Base Runway was evaluated in 1990.²⁵¹ The authors concluded that Building 4305, a World War II Unicon Portable Hangar, individually meets eligibility criteria for nomination to the NRHP under Criterion A. The proposed project consisted of the removal of a late 1970s "office box" and hangar restoration to facilitate its renewed use to house aircraft.²⁵²

A cultural resource survey of the North Base runway margins was conducted in 1990. The survey resulted in the finding of no cultural resources. The proposed construction project entailed the repaving, widening, and lengthening of the North Base runway; however, the construction project was never completely implemented.²⁵³ Michael Perry, CSC archaeologist, conducted a survey for the proposed route of an underground cable along the south side of Lakeshore Drive in the northern portion of the study area. This survey was in addition to the previous surveys that directly relate to North Base.²⁵⁴ Four previously recorded sites are located within the study area. The survey area boundaries were drawn by the Base Historic Preservation Officer to encompass two historic period sites including the Muroc Flight Test Base.

Field Work

Finally, an extensive field examination of intact surface features was conducted for the HAER project. The foundations and

²⁵¹. Kilanowski, Dana V., Richard L. Wessel, and Michael J. McIntyre. *Historic Building Evaluation and Effect Assessment for the Proposed Hangar Realignment of Building 4305, North Base, Air Force Flight Test Center (AFFTC), Edwards AFB, Kern County, California*, 1992, 1-10. Report on file, AFFTC/EM, Edwards AFB, California; Perry, Michael E. *Letter of Findings: Cultural Resource Survey for North Base Taxiways and Runway*, 1990, unpaginated. Letter on file, AFFTC/EM, Edwards AFB, California.

²⁵². Kilanowski et al, 7-8.

²⁵³. Perry, 1990, unpaginated.

²⁵⁴. Perry, Michael E. *Letter of Findings: Cable Installation or Replacement*, 1988, unpaginated. Letter on file, AFFTC/EM, Edwards AFB, California.

other remains of former buildings were surveyed with a Wild TC-1010 electronic theodolite, and the data plotted with computer-aided drafting (CAD) software.²⁵⁵ The results were compared with surviving facilities engineering and original constructions drawings, historic photographs and written records to produce the HAER measured drawings.

Oral Histories

For this study, oral history was used as a primary means of gathering information and augmenting known written records concerning the Muroc Flight Test Base. Oral history personnel involved in this project were familiar with many aspects pertaining to the discipline and the primary topic. However, additional archival research was done by interviewers to enhance their knowledge of the subject and to increase the number of potential interviewees. Seven interviews were conducted in association with the Phase II Cultural Resource Evaluation, five of which contained information pertaining to North Base. The remaining interview pertained to the second half of the Phase II Cultural Resource Evaluation which was not a portion of this HAER documentation project.

Don Thomson and Paul Brewer provided details concerning the Base's early years. Don Thomson, an instrumentation engineer, arrived at the Muroc Flight Test Base in 1942 to work on the Bell XP-63 Kingcobra project. He subsequently worked on dozens of flight test programs at Muroc/Edwards, including many located at North Base. His interview provided historical and cultural data about the Muroc Flight Test Base (North Base) and many of its aircraft programs. The XB-45 *Tornado*, XB-46, XP-58 *Chained Lightning*, XP-81, XP-80 *Shooting Star*, XP-86 *Sabre*, and the TF-86 are significant early flight test programs that Thomson specifically mentioned. In addition, he provided information about buildings and structures such as the Desert Rat Hotel that stood during the early years of the Muroc Flight Test Base.

Paul Brewer, a flight test engineer, arrived at the Muroc Flight Test Base in 1947 to work on the XB-45 *Tornado* program. He provided information about the Desert Rat Hotel and other buildings and structures. In addition, Brewer furnished data about the Muroc Flight Test Base's hangars and various early aircraft projects such as the XP-84 *Thunderjet*, P-80 *Shooting Star*, XB-45 *Tornado*, XB-47 *Stratojet*, YB-49 *Flying Wing*, and

²⁵⁵. MicroStation version 5.0 by Bentley Systems, Inc. (formerly Intergraph, Inc.).

experimental vehicles and the Douglas D-558-I *Skystreak*.²⁵⁶

Chuck Sampley, a long-time area resident, former Base fireman, and employee at the JPL Edwards Facility, provided information not only about the Muroc Flight Test Base's early years but also East Camp, Oro Verde (the Pancho Barnes Ranch), and the town of Muroc. In addition, Sampley supplied information about several aircraft projects and JPL during the 1970s and 1980s. Sampley provided a working-class perspective of the Base. He further discussed changes in firefighting technology and how these changes affected the firemen's daily lives in regard to their ability to perform their jobs.²⁵⁷

Jake Superata, a Northrop mechanic, provided detailed information pertaining to several of Northrop's World War II projects, including the MX-324. Superata also discussed the Rocket Sled Test Track and deceleration experiments. Superata was Northrop's lead mechanic for the project. He was responsible for maintaining the track and preparing it for test runs. Superata provided highly detailed explanations on how the machinery and track functioned.

Robert L. Riedenauer, Lieutenant Colonel, USAF (Ret.), furnished information about North Base during the mid to late 1960s and early 1970s. Riedenauer was involved in the U-2 program while it was located at North Base. Like the other interviewees, he was able to provide information about the North Base's aircraft hangars, buildings, and other structures. However, due to security classifications regarding the U-2 program, he furnished limited information pertaining to this particular program and period.

²⁵⁶. Brewer 1994:2-5, 9-10, 13, 16.

²⁵⁷. Sampley, 7-8, 12-19.

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